HE POLAR RECORD

9, NO. 63, SEPTEMBER 1959

A Journal of Arctic and Antarctic Exploration and Research

Issued by the Scott Polar Research Institute, Cambridge

6d.

THE POLAR RECORD

Editor: L. M. Forbes. Editorial Committee: B. B. Roberts, G. de Q. Robin, Sir J. M. Wordie

Vol. 9 September 1959 No. 63

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AN ARCTIC WHALING JOURNAL OF 1791

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[*MS. received 14 May 1959.*]

In 1956 the University Library of Aberdeen acquired a journal written by one George Kerr, surgeon aboard the Aberdeen whaling ship *Christian*, during a voyage to the whale fisheries in the Greenland Sea, west and north-west of Spitsbergen. The voyage, which was in 1791, took them as far north as lat. 81° N. The journal is seventy-nine pages long, on quarto-sized paper, and written in brown ink in a good, clear hand. A number of whalers' log books exist, recording winds and tides and noting extraordinary events, there are also published memoirs covering several voyages or giving a picture of whaling in general—like William Scoresby's book which includes an exciting narrative of the voyage of the *Esk*, under his command, to Spitsbergen waters, and of her preservation under most difficult circumstances.[1] Kerr's journal is a spirited day-to-day account of an eventful though profitless voyage—the ship returning "clean" with no catch.

The whaling industry in Aberdeen[2] began in 1752 encouraged by the bounty of 40*s*. per ton, paid by the British Government since 1749, on the burthen of all vessels engaged in the whaling industry. In 1792 this bounty was reduced to 25*s*. The first company formed in Aberdeen failed in 1775, but other companies were more successful. In 1783 Messrs J. Gibbon and Co. was founded, owning three whalers, *Hercules*, *Latona* and *Christian*. *Christian* herself only fished for a few years after her addition to the fleet in 1787, but the other two continued to make regular voyages to the north until 1800. Kerr's journal is therefore written quite early in the history of Aberdeen whaling, some 60 years before Lady Franklin chose the Aberdeen whaling captain William Penny to sail *Lady Franklin* and *Sophia* in search of her husband, Sir John Franklin, and the lost Arctic expedition of 1845.

On Thursday 10 February 1791 the ship's company were mustered by His Majesty's revenue officers. The journal proper begins on Friday 18 February when the *Christian* sailed from Aberdeen at noon, accompanied by her owners as far as the harbour bar. She met with a fierce gale, which continued to blow and which laid low the young surgeon for some days. On 4 March they reached lat. 68° 10′ N., and Kerr, now recovered from sea-sickness, writes: "It is almost impossible to keep ones self warm in bed in this weather—the extremities especially. Water and beer freezes now upon our table." It was of course very early in the season. The next day they met a stream of ice with seals upon it. The wind drove the pieces of ice against one another, "occasioning a very disagreeable harsh noise". On Sunday 6 March there was an excessive frost. Kerr's ink was quite frozen and the beer was frozen in the casks. They saw "a

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The whaling ship *Graf Tott* and other Danish, Dutch and English whalers in Spitsbergen, 1777. Reproduced with kind permission of A/S Thor Dahl, Sandefjord, from Bjarne Aagaard's *Den gamle hvalfangst* (Oslo, Gyldendal, 1933).

(*Facing p.* 534)

great deal of what the sailors call *pancakes*, that is small bits of ice broken quite round by rubbing against one another....If the water were strewed all over with biscuits, it would make much the same appearance...the rigging is now quite stiff and unmanageable almost."

Jan Mayen was sighted on 10 March, "the highest land I ever saw". Kerr remarks that he can scarce believe the report that the mountain Beerenburg is five miles high (it is, in fact 2277 metres high). He diverted himself by giving Latin lessons to the Master's boy. The sailors grew anxious at the absence of other ships near the ice in case of misfortune, but, on 15 March, they sighted a Danish vessel, and kept her in sight. The next day Kerr wrote: "The hoar frost flies about here in clouds, like summer fogs in Scotland, and powders everything very finely. A beau could be shaved and have his hair dressed here at a very small expence."

By 24 March they had reached lat. 73° 51′ N. and hailed a number of other vessels, including the elegant 350-ton *Friends* of London. Kerr spent much of his time in reading, writing, music, playing cards, besides trying to shoot "snow birds" (Ivory Gulls) and joining in the attempts to shoot seals from the ship's boats. On 25 March there were thirty-five sail in sight, and indeed they very nearly ran down upon the *Manchester* of Hull. Kerr comments on the strength and sea-worthiness of the many Danish vessels they saw, which he believed to be 15 ft. through in the bows and 7 ft. in any other part of the vessel. On 3 April they witnessed an eclipse of the sun. The shadow of everything that evening appeared green, the shadows of the ropes upon the sails being particularly beautiful. The next day, a boat was lowered in chase of a large seal lying on the ice, which Kerr killed, as well as other smaller seals. Gales and cold made life uncomfortable, and on 8 April, Kerr writes: "The cold is just now as intense as well can be. We must saw our Beef, everything, even in the medecine chest, freezes except spirits of wine. Ones pillow if not aired, feels as cold as ice. I should scarce leave my bed at all were it not for hunger!" The rather fruitless attempts to catch seals continued, either by shooting them with a musket as they lay on the ice floes, or by harpooning them in the water from the ship's boats. One seal was brought in alive, and fell asleep on the deck. All three vessels seen on 14 April had bloody sides. The entry for 15 April is worth quoting in full. "Thick frost flying over the water and strong northwest wind. We sail through streams of weighty ice, but no seals to be found. The ice here is about 30 feet diameter each piece, but not exceeding four feet in thickness. 2 p.m. We have seventy sail in view, all to the N. ward. 5. Our course is north towards the vessels ahead, which are so many in number, and so thick together that they have the appearance of the distant view of a city...." On 16 April they picked up seven seals but had by then given up hope of any large number. By 18 April they had killed twenty-four altogether. It must have been disheartening to meet the *Lively* of London on 29 April with 320 seals.

Preparations began at the end of April for the whaling. Blocks were put upon the davit ends on which to hang boats. The harpoon lines were coiled and with the harpoons placed ready in the boats. They spoke the *Egginton* of

Hull and the *Neptune* of Leith with 190 and 400 seals respectively. They were then in lat. 74° 30′ N., long. 4° E. On the evening before May Day,[3] the May garland was put up—"Some hoops framed into a round figure almost covered with ribbons and hung upon the top gallant stay." The harpoon gun was tried by firing it at casks floating in the water. Kerr sat up the whole night of 1 May to watch the phenomenon of the midnight sun, which, for the first time during the voyage, did not set at all.

On 3 May, Kerr and Mr Booth (the mate) took a boat out to shoot "looms" (Guillemots) but found it impossible to kill any, since they dived at the flash of the musket. Their fowling was interrupted by a visit to the *Young Eagle* of London. Captain Whyte, then in his 37th season in Greenland, had made his passage from Gravesend to lat. 77° N. in about three weeks. "She is", says Kerr, "the largest ship in the Greenland trade, measuring 650 tons and carrying 850, having been formerly a warship, and now cut." Captain Whyte told them that when he left London there was every appearance of a Russian war and that he believed there would be a convoy sent for the British vessels in the north. He gave them newspapers so that they could form an independent judgement of the situation.

On 6 May the *Christian* spoke the *Eclipse* of Lynn, "a very pretty ship"; Kerr observes that "the trumpet the Master of this ship made use of was the only proper one I have seen in Greenland, being modelled exactly to the logarithmic curve". By 7 May they had reached lat. 77° 20′ N., long. 11° E., and pushed on in company with the *Eclipse* to the north-west, through heavy ice. During the afternoon of 8 May, they saw a piece of ice "above a mile in length and about forty feet thick". By 10 May, they, in company with the *Eclipse* and the *Robert* were in lat. 79° 8′ N. Kerr exclaims at the errors of reckoning by the Master of the *Christian*, and at the blows from the ice suffered by the ship, through the counter orders of mate and master.

They sighted sixteen sail lying to on 12 May, and made towards them, the *Christian* being commodore and showing the way, followed by fourteen of the "finest ships in the Greenland trade". However, they soon saw the stationary ships making sail, and decided, since there was obviously no safe station there for ships, and no whales to be seen, to steer for the south-west and clear water. On 13 May they sighted a "Dutch flight", a fly-boat having a broad hull and narrow upper stern with windows. The next day there were sixty-four sail in view, all Dutch, Kerr supposed, both Dutch and Danish ships being far finer painted than the British. A fog enveloped the ships and the *Christian* rang her bell and fired muskets to warn other ships of her approach. Kerr observes: "During this dusky weather I find the *vis inertiae* very powerful. Instead of studying to any purpose, I am sufficiently tired with writing the log, keeping my own journal etc.—A mere *hiatus* in a man's life time."

The weather continued thick, and on the morning of 15 May the *Christian* found herself among seventy-one sail, most of which were Dutch. These vessels "are fully 20 feet above water abaft, they have three rows of cabin windows, one story for the Harpooneers upon the top, the middle for the master, and the surgeon and cook live below. They are kept exceedingly neat and clean." Few

of the ships had met with success in the whale fishery, and Kerr remarks: "If the ships here this season are not greatly surprised with good luck, scarce one half will come out next season." He also remarks on 16 May about the *Christian's* poor timepiece, which, being then nearly three hours before the sun, "will reflect but small honour on the maker".

On 19 May, "having a curiosity to see one of the Dutch vessels", Kerr went aboard one of them, and found her "neat and clean, but ill-shaped. They have one cabin upon the main deck with windows opening to the main deck, and their harpooneers lodge here. The cabin below, which their captain occupys, has windows opening in the stern, and is a very neat apartment. Another cabin below all is occupy'd by their doctor and cook; their windows are often below water in a gale. Not one of them could speak English or Latin aboard this ship." Kerr was also made welcome aboard a Hamburg ship, whose surgeon could speak imperfect Latin, and who treated Kerr to coffee and tobacco. While he was aboard the Hamburg vessel, they spoke a Dutch ship with 4000 seals. On the 20th they lowered boats after a whale, but without success. They saw some "unicorns" or narwhals, and heard from the *Manchester* of Hull that the *Blessing* of London had been lost on 16 May in lat. 77° N. The *Manchester* had picked up nine of her crew from the ice.

The *Christian* had meanwhile come to the edge of the main area of sea ice, to what Kerr terms the "Field", "a large body of ice farther extended than the eye could reach, about ten feet high above the water", to which all the ships made fast with ice anchors. This the *Christian* endeavoured to do, but was blown from her berth by the wind; a Danish vessel took advantage of this to take over *Christian's* mooring. Another Danish vessel ran down on her, and both ships lost whale boats. The ice then closed in and everyone expected soon to be beset. Kerr remarks: "The ships are lying as close to one another here as at a quay or wharf, and make a fine appearance." The ice drifted closer and by 9 p.m. of 21 May, they were completely beset. The ice broke one cable of 6 in. diameter, but they made fast with a stronger one, which made them lie "with as little motion as we could in the Harbour of Aberdeen. About 38 sail to be seen all in the same situation.... The ice to windward of us is as thick as that of the Field, and the pieces from a quarter of a mile, to half a mile in diameter."

Thursday 22 May was an eventful day. At 1 a.m. Kerr got out of bed to see a Polar Bear on the ice. At 4 a.m. they received the news that the captain of the *Friendship* of London had died on board that morning. At 6 a.m. "A harpooneer belonging to the Manchester told us that the *Neptune* of Leith was stove in. That the water was up to the main hatches and that the people were getting their provisions and other necessarys upon the ice. We soon discovered her, about half a mile ahead of us, the yard arms almost touching the water... 9 a.m. The wind blew hard along the Field from N.E. ward. A Dutch vessel broke from her moorings a head of us, and ran foul of us, our damaged boat was stove all to pieces so as to be totally useless. Two of the Dutchmens boats were also stove—In half an hour after, some large pieces of ice broke the Castle of Hull from her moorings and drove that vessel foul of us. Our starboard anchor

stock, cat head and part of our fore rigging was carried away. The Castles stern was partly stove in, and one of her boats crushed to pieces.... By this time I suspected the vessels to be both in danger and got upon the ice; where upon viewing the situation of both ships, I did not think it possible that they could keep free of being stove in for an hour. The Castle's stern was squeezed hard upon our bows, and both vessels were cracking as if they would go in pieces every minute. At this time, the wind luckily changed a little and blew more off the ice and freed us of the danger for a short time at least. 10 [a.m.]. We saw a body of men travelling upon the ice from southward, the gaps among the ice often interrupted their course, and they made very slow progress. 11 [a.m.]. The Neptune seems to be going down fast. A Danish brig is also lost. 2 [p.m.]. We discover the men on the ice at three miles distance carrying a Danish ensign. 3 [p.m.]. We sent away five hands to the people on the ice with some provisions. On their way from the ship one of them fell into the water and was obliged to come back. The rest continue their course. When our people came up to those on the ice they found that they were not foreigners as we had judged, but part of the crew belonging to the Raith of Leith who had left their ship upon seeing a large dead fish. Their ship having been fast to the field and the ice drifting away had parted them for a considerable distance. The ensign belonged to one of their boats, was red, and had a white cross in it which induced us to think it Danish. At 4 the Neptune sunk. The Danish vessel on board of which I was so kindly entertained last Thursday, lies fast between two fields; they are cutting out a dock for themselves in the ice. The Blessing of London had got a fish yielding 40 butts blubber before the gale in which she perished. The Raiths men are now aboard the Lord Hood."

On 26 May, some sixty sail were beset. Kerr lamented the lack of success, but remarked that the voyage would pass away easily enough were it not for "continual disputes between our master and officers which render it disagreeable". On 27 May he made the acquaintance of two Danish boys aged 18 and 14; the eldest was harpooneer and had spent seven seasons in Greenland, and the younger six. They had been to "Mackalina Bay" (presumably Magdalenefjorden, in Spitsbergen), and had seen neither ice nor fish. The Danish boys were worried about their passage home because of the imminent prospect of a Russian war. "The Danish boys are in general very well looked. They have fine eyes, a fine complexion and quite plump. Their old men are very hard featured and have in general a disagreeable aspect." On 28 May Kerr visited the *Frau Lucia* of Luckstadt and admired their fine varieties of bread and excellent butter and cheese.

The burial of the master of the *Maria & Susanna* took place on Sunday 29 May at 1 a.m. The procession, carrying the Danish ensign and a pennant, was joined by the ships' companies of all the Danish vessels in the vicinity. Every ship's company gave them three cheers as they passed, and the body was finally sunk near their ship.

Much visiting went on between the various ships beset in the ice, and Kerr remarks on 31 May: "During these ten days we have been shut up, the sailors walk in dozens over the ice to see one another and are scarce ever free of liquor.

Our ship has not in my opinion been without some Dutch or Danish visitants for one hour, these six days." But he himself also made several visits. He went aboard the Dutch ship *Pro Patria* on the morning of 30 May. He was surprised at the inability of their doctor to speak either Latin or English, as he had believed Dutch surgeons to be fine Latin scholars. He describes his visit as follows: "The upper gallery of this ship is exceedingly elegant, finely painted and the windows very large. The Captain puts one in mind of Falstaff, a great overgrown fellow scarce fit to totter along the deck. He made me understand that he was 50 years of age and had been in Greenland every year since he was 10 years old." He did not think there would be a war with Russia, but should there be one, the Russian men of war might come from Archangel to attack the English and Dutch ships in the north. "After coffee, the Captain's son and I played the fiddle and, as he seemed to like the Scots music, I made him a present of a collection of Scots tunes." On his return to the *Christian*, Kerr found there the surgeon of the *Jong Peter* a most intelligent man who spoke Latin "readily but not correctly", and from whom Kerr learned some Dutch words by asking the names of things in Latin. On 31 May, he was given coffee and milk aboard the *Jong Peter*. The surgeon aboard this Dutch vessel said that her master was a farmer who sowed his crop before he came away to Greenland and went home in time to reap it. At 8 p.m. the same day, Kerr removed the aching tooth of a Danish carpenter.

On Wednesday 1 June there was thick disagreeable weather again, with the ships still beset. Kerr writes: "The roads over the ice from one ship to another put one in mind of the roads from one house to another in the country, about Christmas. The ringing of the Dutch bells for prayers has also something of a resemblance to the ringing of a country church bell on a Sunday morning." That day the ice loosened up a bit, and some thirty-four vessels made fast to the edge of the ice, the others making sail to the south-east, which Kerr thought far the more sensible.

On 2 June he "received account from an Englishman on board a Dutch vessel that when he came away the Dutch and English ships were stopped from passing Elsinore, and that several Dutch vessels had returned home unrigged". The entry for Sunday 5 June lists eleven of the Dutch and Danish ships moored to the ice. Most of the Danish vessels had "C7" on their sterns "in honour of their King Christian the Seventh. They have this in their colours too". Still in lat. 77° N., and still beset. The *Land van Beloften* was stove in by the ice on 7 June. The men brought bedding and possessions on to the ice, while the captain distributed cheese and other provisions among the crew. The same day the *Bosch Hoven* flew distress signals, and yet another ship could be seen with her yard arms touching the ice. "Parties are now travelling over the ice from every quarter to the ships in distress." By 8 p.m. all three ships were totally lost.

Men from the *Christian* went over the next day to the wrecks of the two Dutch vessels to salvage wood, rigging and other articles. Some of the men were struck by the Dutchmen, and the carpenter returned with a deep wound in his arm, received from a Dutchman as he endeavoured to take away the sinking ship's fore topsail. "We have however got ropes, spars etc. to a

considerable value.... All the ships near the wrecks are employed in hauling away what they can lay their hands on."

On the 10th one of the harpooneers thought he saw land, but Kerr dismisses this saying: "I cannot suppose that we are so far to the Eastward." They received accounts of ten vessels being lost, but could not rely on the reports being true. Kerr shot a seal on the morning of the 11th, laid it on the ice near the ship to attract the birds, and thus was able to shoot three "snowbirds" and one "burgomaster" (Glaucous Gull). He remarks that the latter is a very powerful bird and nearly killed the ship's dog after it was brought on board. Kerr obtained some very fine quills from its wings.

The *Christian* continued drifting to the southward, and a water sky showed that the edge of the ice was not far off. At 6 p.m. on 12 June some eight Unicorns (Narwhals) were seen "in a hole alongside. They are very pretty, having spotted skins and each a fine twisted horn. About 16 feet long, and 8 round." The ship's latitude by observation was 77° 2′ N.

On 13 June the *Christian* was still beset. News came, from some Dutchmen, of two vessels lost to the eastward. One small "fish" and many unicorns and seals were seen in the water, but there was no room to kill any of them. Kerr remarks sadly: "No-one entertains any hopes of a fishing now; everyone is anxious for an opening in the ice alone."

From 14 to 16 June, the wind blowing from the S.S.W., the ice pressed close around the ship; so much so that the vessel was "squeezed" on the 16th and all provisions were got out on deck. They "expected to share the fate of the three vessels lost, every minute. Every person on board was employed in getting his bedding etc., ready to haul over the ice, and seek their quarter.... We have no expectation of the vessels getting safe out from the ice; and that for many reasons."

There is a short entry for 17 June: "Calm close weather all this day. Nothing new to be seen or said. Every person beginning to be anxious on account of their situation here." On 18 June "the ship's larboard quarter was stove in and she began to require one pump constantly going". Notice was sent to the *Eclipse* of the *Christian's* situation, and Captain Pilmer sent his whole crew, except for six men, over the ice to help. "The ice was shoved off a little by means of a spare fore top mast", the vessel eased and the leak stopped by degrees.

On the 19th the captain's son of the *Pro Patria* visited the *Christian* to see how she fared. Kerr escorted him back to his ship, as a bear was prowling about. This bear was eventually killed by the crew of a Bergen ship after Kerr had fallen through the ice and fired unsuccessfully at him.

There was no change on the 20th, 21st and 22nd, when their latitude was 76° 26′ N. Kerr remarks: "This miserable situation of ours nothing changed. No view but of lodging in Greenland for a winter and for ever." He writes on the 23rd: "Hazy weather today, fresh breezes from the N.E. No alteration. The ship still in as much danger as formerly. It is impossible for me to do anything in this situation. I cannot think of beginning anything which shipwreck will not allow me to finish. And the continual cracking of the vessel will not allow of sleep." He writes somewhat wearily on 25 June: "The ship was

again squeezed terribly among the ice and shoved out of the water near 18 inches, but we are hardened to such scenes now, and think nothing of them. No better prospect of getting clear than ever." On the 26th: "Thick hazy weather, with variable air. I am now weary of writing so many times the very same over and over again." They were in lat. 76° 11′ N.

His boredom was alleviated on the 27th by a visit to the *Eclipse* to see a man near death, and delirious, "seized with gangrene in his feet". On his way back, Kerr was much entertained by the singing of five Danish surgeons whom he found aboard the *D'Lillie* of Hamburg. One of them spoke Latin well, and they all "sang several English airs infinitely better than I ever heard them sung upon our stage".

The 28th was an eventful day. "A large piece of ice pressed up by a flow to leeward began to press upon the ships quarter about 3 p.m. and remained pressing still harder for some hours till we were obliged to loose our main top gallant sail as a signal to the Eclipse that we were in danger. Before their crew came the ship was stove in, in another place than formerly. Two pumps were required to keep the vessel afloat, and the leak gained even upon both. The Eclipses crew came readily. We also had the assistance of 3 Danish crews who laboured as hard as our own men at the pumps, and kept off the Dutchmen who were now come about us for plunder. All our efforts were fruitless; the ship continued going down with us. The provisions were tossed upon the ice and some of the sails were cut down, no-one entertaining the least hopes of her safety, when very unexpectedly a fresh breeze sprung up from the westward, and blowing hard, eased the ice away from the ship. The Eclipses carpenter and our own then endeavoured to stop the leak and succeeded so far in half an hour that one pump was sufficient. Within an hour we had only 7 inches in the hold and the ship quite free of the ice, which drives to eastward. Midnight: the ship, contrary to all expectations makes very little water. Our provisions are again on board, and we yet entertain hopes that the *Christian* shall carry us to *Aberdeen*."

Kerr woke on the 29th "agreeably surprised...to find the ice at two miles distance from the ship, and a strong westerly breeze still continuing". The ice continued to drift away and the next morning the *Christian* cast off from the main pack and sailed for some 5 miles in clear water. She was stopped by heavy ice and made fast to a floe, in company with the other ships, the *Eclipse* being two miles away. The weather was thick and foggy and visibility became less than half a mile. The *Christian* worked away through thick ice to southward and eastward, trying to find a passage out. The *Eclipse* gave up and returned, with several Dutch ships, to her berth in the main pack.

The fog continued and the ice was still heavy. On 3 July he reports an encounter with a she-bear and her cub. "About noon we saw two creatures swimming in the water which we took to be ducks, but upon coming nearer the ship we discovered them to be two bears with their heads above water. We lowered two boats and gave chase to them, and as they were in the water we soon came up with them. The one was a large she bear and the other a small one her cub. Upon the boats coming up the old one waited for the cub, and took

it upon her back; but being unable to make away at that rate, one of our harpooneers ran a lance thro her. She made little resistance and soon was killed. The small one swimmed about till it saw its dam killed, and then attempted to get off, but our men soon came up to and ran it through with a lance. It was very resolute and jumped several times to get into our boat before it was killed. They were both towed on board and their flesh salted up in case of necessity. I dissected the thorax and abdomen of one of them and found a bone in the stomach of the largest as long as a mans finger which I kept as a curiosity."

From 4 to 10 July all hands were employed at the exhausting task of warping the ship through fairly heavy ice. The first day they dragged the ship nearly twenty miles to the eastward, but the other days little or no progress was made. Kerr and Mr Booth kept watch very often for 8 hours while the weary crew "slept to be made ready for another trial". He reflects that they were lucky not to have needed assistance as few ships were in sight, and those at a distance. On the 11th they warped along a lead of clear water for 2 miles—"we have not made so much for a good while past". His entry for that day continues with a few remarks about the noise made by the sea ice: "I have for several days occasionally heard a very loud report like that of a piece of cannon. I find it proceeds from large pieces, suddenly rising. They jump to a surprising height above the water upon being thus liberated. Some I have seen as large as the hull of our ship. Were any of these pieces to touch a vessel in their ascent, they would dash her to pieces in a moment."

The warping or lying beset continued. "What is very much against us", writes Kerr, "is that the ice no sooner slackens a little than the wind turns southerly and stops us." On the 13th they were in lat. 75° 50′ N., and the next day blown north by a contrary wind to 76° 8′ N. He exclaims on the 14th: "Another day of rest—quite close beset, and a contrary wind. What a fine school for an impatient man!" Anxiety was felt about the provisions lasting out, and the men were put on short rations. A similar day followed on the 15th, and again he writes on the 16th "*Semper idem.* Unable to stir a foot from the place, we drift about at the pleasure of the wind. I scarce know whether to give up hopes of getting out or not. However it is the best plan to retain them as long as possible. The ice must open at some future period, but by that time our provisions may be expended...."

The 17th, 18th and 19th have brief lines saying in different ways: "The same as yesterday in every particular." Some warping was possible on the 20th, and on the 21st they "got sail upon the ship, the ice being much more open than formerly, but still as heavy pieces as ever. As we pass along we see several pieces of foul ice with marks, which show that ships have been lately there." At 2 p.m. a "considerable swell" was observed and by 4 o'clock the *Christian* was sailing in open water again "to the great satisfaction of every person on board....This day having regained our liberty, the crews allowance was advanced to the usual rate." The ship received some hard knocks from the ice at the edge of the pack. The ship had to "work in the winds eye however, that is, to S.E. to keep clear of ice to the S. ward of S.S.W."

There comes a disgruntled entry on 22 July: "Instead of leaving the ice directly, as we expected, the master informs us that he intends to steer along the course of it, S.S.W. and S.W. by W. as far as the latitude of 71, intending to take a departure from Beerenburg in that latitude. While the weather continues as foggy as today, I should as soon think of finding a needle in a stack of hay as Beerenburg among the ice of Greenland. However, as we always fall in with ice to the S.W. ward, a few days will wear out the resolution of taking a departure from J. Mayen Island." This indeed proved to be the case, as sighting the island was made difficult in the hazy weather, and the ship also met some heavy streams of ice. An observation on the 25 July placed them in lat. 73° 42′ N.

On the 27th Kerr writes: "As I expected we now begin to give up hopes of seeing J. Mayen. This morning we began to get our steering sail booms rigged upon the yards, and the top gallant royals set." But they were not to leave the northern seas before Nature had played a practical joke upon them. "At 10 p.m. one of our harpooneers called from the mast head that he saw a ship to N.E. ward. Within two hours the master and carpenter said they could see the ship from the deck and that she was lying to for us. That the fore yard was aback, the main yard drawing full, the gib ran down etc. They made it to be a Copenhagen brig who was with us at the Field. Mr Booth thought it was a lugger. It proved to be a real Greenland ship, i.e. a piece of ice!!!

"At noon took our departure from Greenland taking it from the S.E. point of a stream of ice. Our latitude by observation is 73° 25′ N. But as to our longitude we have very different opinions. The master and mate suppose themselves in 6 East. I suppose our longitude to be 2 East. A harpooneer who keeps a reckoning supposes his to be 0. Another 4 East. What kind of a landfall we shall make God only knows. The course is to the S.S.W. 4 to six k[nots] all this afternoon."

This speed was maintained during the next few days. Kerr occupied himself in making a fair copy of the log for the custom house, a provision book, etc. On 2 August "we saw a ship to leeward...like every other ship in Greenland she soon left us....The nights now begin to be considerably dark and last for about four hours....We now suppose ourselves to be to the N.N.E. of Shetland distance 270 miles." The ship steered directly for the coast of Norway. Kerr writes on 3 August, "I am pretty certain from the appearance of the sky that the land is not 25 leagues off. I suppose it to be the stadland of Norway. If the war is really declared between Denmark and England we had better take care of going too near the enemys coast, if the wind will permit us to keep off.* The ship mentioned yesterday left us very fast and is now out of sight going to the S.S.W. We got our cables bent today to be in readiness if a gale should force us inshore. $4\frac{1}{2}$ knots." On the 4th, "...We know not what distance from the land we may yet be, having seen nothing of it, but we keep two men upon the outlook upon the forecastle."

* Norway at that time was joined to the kingdom of Denmark. The French Revolutionary Wars (1792–1802) did in fact break out the following year, but hostilities between England and Denmark did not begin until 1797, ending with the destruction of the Danish fleet in 1801 at the battle of Copenhagen.

A gale blew up on 5 August, sail was shortened, and the pump kept going to keep out the great deal of water which the ship made. "We now find that our departures have all been taken too far to the eastward. All our calculations are now ashore on the coast of Norway. Thank God the ship took the least departure. At noon saw the sun and found our latitude to be 62° 50′ N., 40 miles to the northward of the Stadland, and 30 to the northward of Dronthem...." On the 6th they came alongside of a snow (a brig-rigged vessel), "come from Greenland...I do not recollect seeing this vessel in the country at all". The snow had four "fish". They sighted another ship coming from Norway, but upon a nearer approach "we find this is also a Greenland ship. We cannot tell what ship, but can see the garland which proves her to be British." The gale continued on 8 August. All three vessels endeavoured to beat to windward. Kerr remarks that as the sides of the snow "are new scraped and painted, we suppose her to have come from Mackalina Bay" (Magdalenefjorden in Spitsbergen) "where she has an opportunity to refit before coming to sea...Lat. ob. 61° 34′".

They sighted the coast of Norway on 8 August and wore away to the north to avoid the rocky coast. Once clear, they ran on course before a north-west wind. On the 9th day they were on course for Buchan Ness, and observed a great many shoals of herring, "many of them half a mile in diameter". They sighted Scotland on the 11th and the next day at about 7 o'clock in the morning, the steeple of Peterhead. At noon they sighted Aberdeen, but there was such a sea running that no boat could come out to them, and they had to anchor in 12 fathoms opposite Don mouth. But the cable broke and the ship drifted away from her buoy, and had to put to sea till 3 a.m. 13 August and home at last, but not without difficulties with wind and tide. The *Christian* struck twice on the bar as she entered the harbour of Aberdeen.

The journal ends with an elaborately scrolled "Finis", but there is a note after this, written some 13 years later: "After having lost this boyish journal for fourteen years, or at least more than thirteen, some facts remain very strong in my memory which are not mentioned. One is the freezing of the spirit cask and the men carrying shovels full of coals to thaw it which I suppose to have happened Apl. 8th. Another—our proceeding so far to the north as 81° 7′, of this there is no note in the journal, but I perfectly recollect it, as collected from the dead reckoning. I think it is in the log book I kept in possession of Brebner and Co. The effect of cold upon wounds in preventing suppuration, I have mentioned in a separate note book." So ended an adventurous but fruitless voyage.

Acknowledgement

The author is indebted to Dr W. Douglas Simpson, O.B.E., Librarian of Aberdeen University, for drawing her attention to this journal and for the opportunity to study it in Cambridge; also to Mr G. P. B. Naish of the National Maritime Museum for his helpful comments.

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Appendix listing ships encountered by the ship "Christian" of Aberdeen during an arctic whaling and sealing voyage in 1791, mentioned by name in George Kerr's journal.

20 March	*Friends* of London, Capt. Stevens (350 tons)
21 March	*Sims* of London, Capt. Clarke
23 March	*General Boyd* of London
25 March	*Gibraltar* of Hull (fine figurehead—young lady sitting with a child on each knee, and an olive branch spread over their heads)
	Manchester of Hull
27 March	*Lively* of London
29 March	*Blenheim* of London
30 March	*De jong Rachel de Altony* (Danish brig)
1 April	*Dundee* of Dundee, Capt. Soutter
3 April	*Robert* of Peterhead
4 April	*Sarah* of Liverpool
	Dianah of Hull
	Castle of Hull
	Edward of London
	Raith of Leith
5 April	*Unicorn* of London, Capt. Rogers
	Liberty of Kirkwall (90 tons)
	Lion of London (large brig)
	Success of Dundee
6 April	*Rodney* of Dundee, Capt. Frogget
10 April	*Tay* of Dundee
11 April	*Jason* of Shields
12 April	*Sarah* of Hull
	Elizabeth of Hull
13 April	*Providentia*, *Concordia*, *Eliza* — Danish brigs
	Blessed Endeavour of Dunbar
	Princess of Wales of Dunbar
	Enterprise of Hull
16 April	*Lyon* of London, Capt. Peterson (owner)
18 April	*Symmetry* of London (500 tons)
	Lion of Liverpool (with 8 guns on quarter deck)
19 April	*Amphitrite* of Liverpool
	Peggy of Liverpool
21 April	*Friendship* of Leith
22 April	*Lord Hood* of the Ferry
29 April	*Lively* of London, Capt. Scott
30 April	*Egginton* of Hull, Capt. Allen
1 May	*Neptune* of Leith (sunk 1791)

3 May	*Young Eagle* of London, Capt. Whyte (600 tons and carrying 850. "Largest ship in Greenland trade"—Kerr, 3 May. Formerly a warship)	
	Leviathan of Liverpool ("neat middle sized ship")	
6 May	*Eclipse* of Lynn, Capt. Pilmer (299 tons)	
9 May	*Dianah* of Dunkirk	
11 May	*Truelove* of Leith	
12 May	*Bounty* of Leith	
	Perseverance of Liverpool	
	True Love of Hull	
	Henrietta of Whitby	
15 May	*Vrow Maria*	Dutch
	D'Vissers Hoop	Dutch
	D'Hoop	Dutch
	Oakhall of London	
16 May	*Hawk* of Liverpool	
	Pilgrim of London	
19 May	*Friendship* of London	
20 May	*Morgenstern*	Danish
	D'Maria & Susanna	Danish
	Groenlandia (Dutch)	
	Vreede (Dutch)	
22 May	*Blessing* of London, Capt. Ainslie (sunk 1791)	
25 May	*D'Land van Beloften* (lost 1791)	
	D'Enigket (Danish)	
	D'Tweede Patriot	
28 May	*Frau Lucia* of Luckstadt	
30 May	*Pro Patria* (Dutch)	
	Jong Peter (Dutch)	
4 June	*Cornelys*	
5 June	*Koning Salomon* (Dutch)	
	Hollandia (Dutch)	
	Kongens Cave (Danish)	
	D'Patriot (Danish)	
	D'Lillie (Danish)	
	D'St. Peter (Dutch)	
	D'Frau Margaretha (Danish)	
	Frederica (Danish)	
	Defemwenner (Danish)	
	Jager (Dutch)	
7 June	*Bosch Hoven* (lost 1791)	

LAUGE KOCH'S EXPEDITIONS TO EAST GREENLAND, 1926 TO 1958

BY J. W. COWIE*

[*MS. received 27 April 1959.*]

The early exploration of east Greenland between lats. 70° N. and 82° N. was the work of several nations, and Danish, Swedish, German and British expeditions all played their parts in it. In the last three decades, however, although other groups have made valuable contributions, the expeditions under the leadership of Lauge Koch have been of paramount importance by virtue of the large numbers of scientists involved, the range of the studies, and, in particular, the continuity of effort. This continuity has enabled an unusual degree of foresight and planning to be applied to the operations. Even in these more favoured circumstances, however, "greater results might possibly have been obtained if the means had been ensured beforehand, so that the work could have been planned for a longer period of years at a time".[1] It has been the policy to concentrate on geological survey as the basic scientific inquiry in this uninhabited, almost virgin, territory. This emphasis on geology has, in turn, stressed the need for detailed geographical information, and stimulated topographical survey to produce an adequate coverage of medium-scale maps for a large part of the region. Other fields have not been overlooked, and biologists—studying the fauna and flora of both land and sea—meteorologists, glaciologists, hydrographers, and archaeologists have been included in the parties.

Lauge Koch, who is himself a geologist and cartographer, first worked in Greenland in 1913, and from 1916 to 1918 was a member of the Second Thule Expedition, under Knud Rasmussen. From 1920 to 1923 he led the Jubilee Expedition to north Greenland, making a notable journey around the north of Greenland accompanied only by Eskimos. The series of Danish expeditions to east Greenland under his leadership began in 1926 and ended in 1958. Such continuity of leadership, interrupted for any considerable period only by the Second World War, is without parallel in the history of polar expeditions. The changes which have taken place in the techniques and material employed by these expeditions are manifold; in contrast, the source of the scientific personnel, and their form of participation, has shown little change. The numbers involved have fluctuated considerably from year to year and a significant proportion has returned many times. The figures for "man-summers" and "man-winters" are probably the most pertinent in indicating the scale of activity. Before the Second World War these amounted to 566 "man-summers" and 102 "man-winters", while the corresponding figures for the post-war period are 642 and 24. The figures do not include Greenlanders employed for shorter periods, flying-boat crews who have transported men and supplies, and various

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exceptional cases. The reduction in the number who wintered, from 102 to 24, was partly the result of the introduction of air transport for field groups, enabling more work to be done in the short summer season with its favourable weather and widespread snow-free conditions. The largest pre-war summer group was 109 men in 1933, and the post-war peak was 120 in 1950. These numbers include those concerned primarily with economic geology. The largest wintering party was the exceptional case of 23 in 1937–38, when the summer relief ship failed to reach all the bases, and the second largest was 19 in 1932–33; post-war winters have never seen more than 6 (1949–50) remaining in Greenland.

The expeditions have included members from most countries of western Europe at one time or another, but mainly Scandinavians, Swiss and, latterly, British. The main purpose of the expeditions being scientific, and the numbers being large, there has always been a degree of specialization particularly during the summer and at the bases. Examples of this policy are, (i) the employment of professional cooks at the main base, (ii) the restriction of the duties of air crews to flying, and (iii) placing each motor boat in the charge of one man. In summer and winter a nucleus of Danes with long experience of conditions in east Greenland, in some cases as trappers, have been concerned with boat and sledge travel.

The members of the first expedition, in 1926, were three geologists, two Danish and one British, and two Greenlander sledge drivers. They wintered at Scoresbysund settlement in their own building and were able to travel in that area during the open season in a motor boat. In the late autumn and the spring of the following year Koch, accompanied by Greenlanders, made sledge journeys northwards up the east coast and into the inner fjords, as far as Danmarks Havn, in lat. 77° N. In 1929 these investigations were followed up by a ship-borne summer expedition with eight Danish and Swedish scientists and a total strength, including the crew of the ship, of twenty-three. The ship, the *Godthaab*, remained with the expedition, which also had three motor boats and four other boats. With ample boat transport, a considerable area of the fjord region between lats. 72° N. and 75° N. was successfully reconnoitred by seven geologists and one botanist. The expedition in the summer of 1930 was of similar size, with three geologists, a botanist, an ornithologist and a meteorologist. In 1931 funds were obtained for a three-year expedition and two ships were allocated for use during the summers. This period saw the peak of pre-war activity, with wintering parties of about sixteen men each year. They were based on three large stations, built in 1931 and 1932, on Hochsetters Forland in lat. 76° N., Clavering Ø in lat. 74° N., and Ella Ø in lat. 73° N. These were staffed with radio operators and Greenlanders, who were employed as sledge drivers. Radio communication was used increasingly between ships, bases, boats and aircraft. In addition to these main stations, smaller huts were built at two other places, one between Scoresby Sund and Ella Ø, and another between Ella Ø and Clavering Ø. The passage of the ships through the ice in

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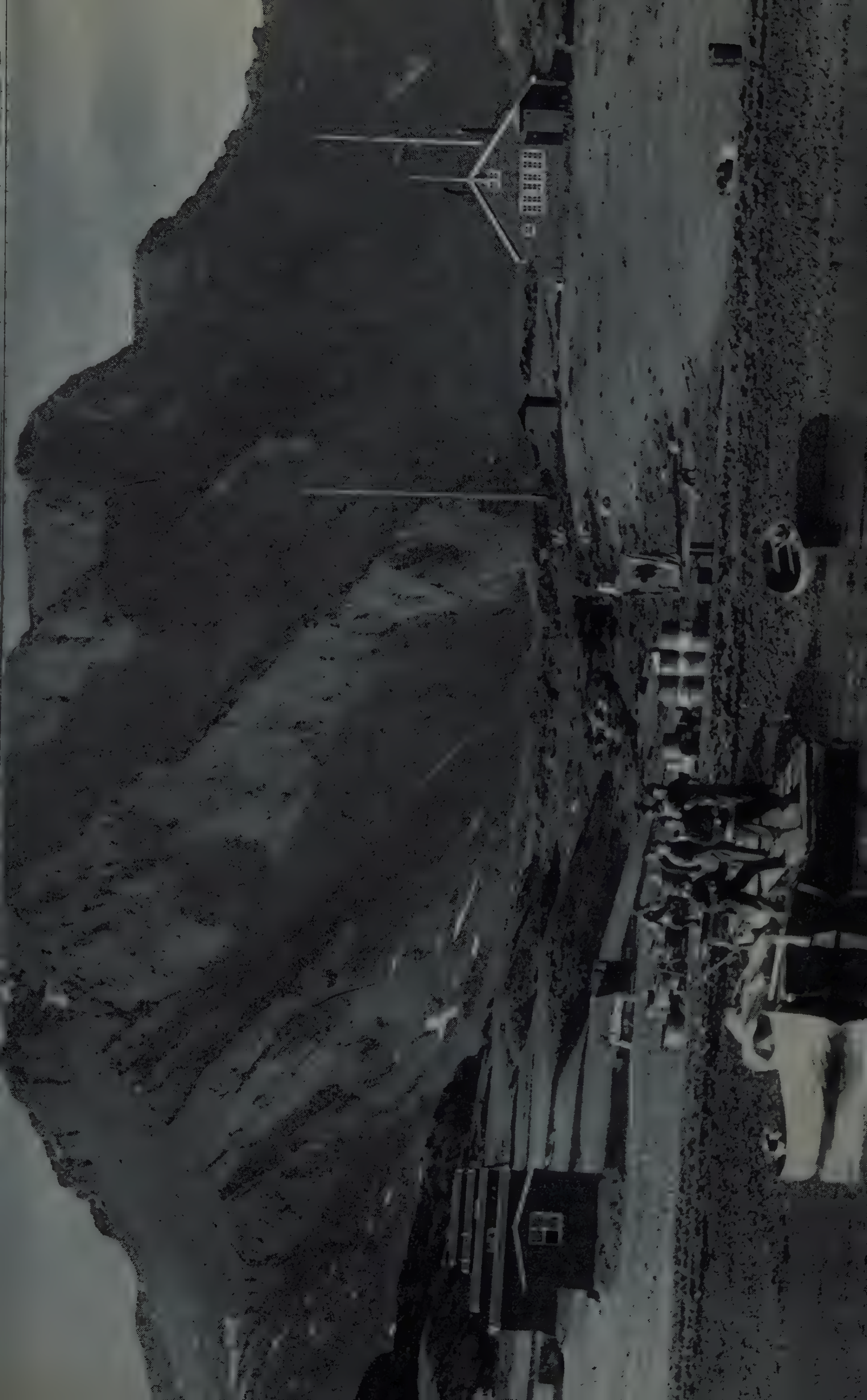
Landing beach and buildings at Solitaerbugt, Ella Ø, east Greenland

Photograph by J. W. Cowie



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1931 epitomizes the uncertainty of this method of transport compared with aircraft, for an average of 25 days was spent in the ice belt followed by 28 days working in the coastal waters and just over 2 days returning through the pack.

Topographical mapping was intensified in 1931. A geodesist and cartographers wintered, and in 1932 four parties of cartographers were in the field together with air photography parties. The aircraft used were two three-seater, open cockpit, single-engined Heinkel seaplanes of the Danish Navy. The cartographic work was thus reorganized on the basis of air photography, controlled by trigonometrical surveys on the ground. In addition, the seaplanes were used for reconnaissance flights in planning the geological programmes, and to assist the navigation of the ships through the ice. Another change in 1932 was the use of Icelandic ponies for transport in less rugged country, and these continued to be used until the end of the summer of 1949, with up to eleven animals employed in one summer. Local grass had to be supplemented by hay from Iceland and, in general, a man could not care for and control more than two ponies at a time, especially when Musk-oxen exercised a disturbing effect. They were most suitable for the transport of heavy loads over short distances in relatively level terrain, and were used for long journeys of up to four weeks duration in 1936 and 1938.

The summer of 1933 was the most favourable the expedition experienced, and it stayed in east Greenland for 66 days. Ice obstructed the ships for only a few hours, due to the aid of air reconnaissance. A mining party worked on Clavering Ø, examining the possibilities of deposits of gold-bearing pyrites. The unusual ice conditions enabled the *Gustav Holm* to penetrate northwards along the coast as far as the Norske Øer, in lat. 79° 05′ N., long. 17° 49′ W.—the farthest point reached by a ship. Flights made by Lauge Koch during the voyage included the first air reconnaissance of Kronprins Christians Land and Mylius Erichsens Land, reaching across the mouth of Independence Fjord to the south-east coast of Peary Land. These northern regions could only occasionally be reached by aircraft from the south, so Lauge Koch led an expedition to Spitsbergen in 1938, in order to investigate them from the east. Flights were made from Spitsbergen in a two-engined flying boat during May over the land south of Independence Fjord, and over Peary Land. In 1934 the expedition was reduced to one ship and one seaplane, and this small-scale activity continued until the summer of 1936, when another expansion took place with a two-year expedition. The topographical mapping had now been completed and the scientific work, which was entirely geological, was greatly helped by the provision of proof-copies of new detailed maps issued by the Danish Geodœtisk Institut. In 1937 other sciences were represented, and the number of stations was increased by the erection of a new building in the interior reaches of Scoresby Sund, and the re-occupation of the hut at Scoresbysund which had been used in 1926 and 1927. Ella Ø and Clavering Ø were not relieved, and the men there had to stay a second winter. The last pre-war expedition of 1938 was

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Kap Oswald, Ella Ø, east Greenland. Solitaerbugt station on left

Photograph by E. Hofer

somewhat pre-occupied with the relief of the personnel who had wintered during 1937–38, and, the ice again proving troublesome, great caution was exercised before parties were put ashore. Investigations went ahead, however, and for the first time geologists were able to fly over their working fields.

All expedition activity ceased by the winter of 1939. The station on Clavering Ø was destroyed in 1943 by a German military party, which also put the radio equipment at Ella Ø out of commission but left the building intact.

In 1947 a small expedition returned to east Greenland with one ship. By the following summer a Norseman cabin seaplane had been acquired, a notable advance, for this sturdy aircraft was able to move parties with supplies and provisions from place to place in addition to carrying out reconnaissance and air photography. From 1949 until 1958 two such seaplanes were in operation, flying a total of 1100–1200 hours each, during the short summer. This increase in speed of travel and ease of access to remote lakes and isolated ice-free areas of the sea lessened the dependence on motor boats, particularly as the geological working areas became more scattered. In 1948 the discovery of large deposits of metalliferous ores in Scoresby Land made a considerable impact on the fortunes of the expedition: the single ship was supplemented by a second in 1949, and in 1950 two ships were again allocated. Icelandic flying-boats were employed for the first time to carry personnel to Greenland, and landings were made in the ice-free inner fjords. Aircraft were seldom delayed by weather and accomplished the journey in a few hours, a contrast with the length and uncertainty of sea journeys. The success of these air operations led to a radical change in 1951 when, for the first time, there was no expedition ship. All the personnel were taken by air from Europe to Iceland in wheeled aircraft and then on to Greenland, as soon as the fjords were free of ice, in flying-boats. Since then only equipment, provisions and fuel have been transported by sea, and in the regular transport vessels. These changes in transport arrangements were not the only new feature, for, with the advent of larger and longer range aircraft, new regions were opened up that had previously been inaccessible. The need for year-round access to the mines led to the construction of an airstrip near Mesters Vig, which was first used in 1952, and it became possible for the journey to Greenland to be made in four-engined wheeled aircraft. Also, groups were now able to arrive in Scoresby Land and begin work in May.

Until 1952 the small parties based on Ella Ø during the winter used dog sledges for longer journeys, and ski and foot travel for shorter distances and mountain climbing. In September and early October motor boats were useable and these were again put in the water some time in June or July, but between these dates no mechanized transport was employed. After mid-1952 there were no more wintering parties and the dogs were disposed of.

The next step in the evolution of technique was the introduction of helicopters. These machines were used successfully for topographical mapping by the Danish Geodœtisk Institut in 1954; in 1955 and 1956 their use was extended to the geological work of the expedition, and results were speedily

obtained in areas which otherwise could only have been reached by long and difficult journeys.

The scope of the scientific work during the post-war years and the geographical spread of the working fields are considerable and space will only allow for a small number of examples. Two of the major projects have been the mapping of the late Pre-Cambrian sediments by Swiss geologists under the general guidance of Professor L. Vonderschmidt; and investigations of the igneous and metamorphic rocks and sediments found farther west, in the inner fjords and nunataks of the ice sheet, by Professor E. Wenk, J. Haller and others.

The geology of the Devonian rocks has been of special interest. H. Butler has been mainly responsible for the stratigraphy and tectonics, but the collection and description of the rich vertebrate faunas, which aroused worldwide interest, has been carried out by palaeontologists from Sweden and Denmark. The Cambro-Ordovician strata, and those of Jurassic and Cretaceous ages, have been studied by Danish and British workers, with important results. In fact rocks from all parts of the geological column have received attention. The geologists have benefited from the services of professional photographers, and a collection of more than 20,000 air photographs has been formed. These large-scale investigations depended on the reasonable guarantee of continuity provided by the expedition, and would hardly have been feasible without the close co-operation between universities and the expedition. The provision of a permanent headquarters in København, with administrative and secretarial staff, has provided a focal point. During the winter months Koch has been able to visit the research teams and maintained liaison with them, and between them. Thus the scientists, after summers and winters spent in field work, usually carried out their laboratory investigations and prepared their reports in university departments, and will continue to do so until the results are completed.

Swiss geologists, with the assistance in many instances of professional climbers, and supplies dropped from the air, have made journeys among the spectacular alpine peaks of Scoresby Land and explored the innermost nunataks far to the west, with ascents of Petermanns Bjœrg and many other high peaks. In 1951 a journey was made by members of the expedition to examine the nunataks between lats. 72° N. and 74° N. in co-operation with the French expedition led by P. E. Victor, who provided a Weasel tractor as transport on the ice sheet.

In 1952 and 1953 two parties of geologists were taken by flying boat to northeast Greenland, and landed on lakes and fjords in the region south of Independence Fjord, in lats. 80° N. to 82° N. Considerable quantities of aviation fuel were also carried so that a seaplane, which followed later, was able to operate from the ice-free lakes and fjord heads in this region. Although long foot journeys were still necessary, it was possible to move rapidly and widely over these regions which are beyond the limits of navigation by sea. In 1953 a party of two was landed on the shores of Friggs Fjord, a branch of Frederick E. Hyde Fjord, and made the first geological traverse of the mountains of north

Peary Land, visiting Kap Morris Jesup in lat. 83° 39′ N., the northernmost point of land in the world. In 1955 similar operations were carried out with a seaplane based on Langsø, south of Bessels Fjord, covering the region between there and Lamberts Land. In 1958 further flights by flying-boats brought fresh results concerning the geology of north and north-east Greenland.

Although important financial assistance was obtained from private sources before the Second World War, various departments of the Danish Government supplied a large proportion of the funds. Since the war expeditions have been supported almost entirely by grants from Ministeriet for Grønland, but co-operation with the great patron of Danish science—the Carlsberg Foundation—has been maintained. The published results are almost entirely to be found in *Meddelelser om Grønland* and, here too, government contributions play an important part in meeting expenses, but the amount provided by private funds such as the Carlsberg Foundation and the Rask-Ørsted Foundation has been, and still is, of vital importance. A bibliography of published accounts was issued in 1954.[2] These publications now cover some 20,000 pages.

Acknowledgements

The author thanks Dr Lauge Koch for supplying information for this article, and Professor W. F. Whittard and Dr D. T. Donovan for reading the manuscript, but is solely responsible for its content and accuracy.

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UNITED STATES SEA ICE PHYSICS PROJECT, 1954–59

BY W. F. WEEKS*

[*MS. received 22 February 1959.*]

In 1954 the Geophysics Research Directorate of the Air Force Cambridge Research Center (AFCRC), at the request of Northeast Air Command, United States Air Force, organized a study of the physical properties, growth, and bearing capacity of sea ice. The object of the study was to gain information about the conditions under which various aircraft and vehicles could operate on sea ice, for supply and rescue purposes. The Navy Hydrographic Office (NHO) and the Snow, Ice and Permafrost Research Establishment (SIPRE) of the Army Corps of Engineers also took part in the project. The spheres of interest of each organization were as follows: AFCRC, the application of geophysical and crystallographic methods to the study of sea ice; NHO, the details of the relations between meteorological conditions and the growth rate and general physical properties of sea ice; and SIPRE, the variation of the strength of sea ice as determined by small-scale field tests, and the application of this information toward an analysis of the bearing capacity of sea ice.

Hopedale, Labrador, was selected as the first field site because it offered a sub-Arctic climate, a sheltered harbour, and sea ice suitable for bearing strength tests. Field work was started on 4 January 1955 by a small party of AFCRC and NHO. During the winter micrometeorological observations and a series of oceanographic stations were completed. Studies were also started to determine the elastic constants of sea ice by seismic methods, and to measure the tensile and compressive strength of sea ice. Early analysis disclosed that, even in the narrow temperature range experienced at Hopedale, the physical characteristics of the ice varied considerably, and that precise testing procedures would be necessary before the cause of the variation could be understood.

During the second field season SIPRE joined in the field studies. Work was continued at Hopedale with revised test procedures and equipment that had been used the previous year by SIPRE on Distant Early Warning (DEW) Line sites. Several sets of small sample strength tests were completed with extensive salinity and temperature control. A study of the structure of sea ice was begun, deflectometers were used to study the flexural waves produced by moving vehicles, several large-scale load tests were completed, and micrometeorological and seismic studies were continued.

The following winter, 1956–57, the field site was moved to Thule, Greenland, in order to take advantage of a better established supply route and readily available heavy equipment. Thule also offered the opportunity to study a thick sheet of sea ice under more typically Arctic conditions. Studies were continued of the structure of sea ice, micrometeorology and ice growth rate, the determi-

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nation of elastic constants using seismic methods, and the measurement of the flexural strength of young, highly saline ice. Deflectometer studies were made of the landings of heavy aircraft and of a 20-ton fire engine moving at varied speeds across the ice surface. In addition, heating units were installed in a small shack on the pier and strength tests were performed at controlled temperatures. A study was also completed of the horizontal and vertical variation of the salinity of young sea ice.

During the 1957–58 winter field season AFCRC carried on the work alone, and with a reduced staff; however, it was possible to put a small party into the field at Thule during both the freeze-up and break-up periods. Seismic, deflectometer, and horizontal salinity variation studies were continued and a series of resistivity measurements were initiated. In addition, preliminary measurements were made of the physical properties of artificially flooded sea ice. There have been, as yet, no field investigations during the 1958–59 winter field season.

Although the data collected during the project has not yet been completely reduced, an attempt can be made to summarize the contributions of the project. These are:

(*a*) measurements of the strength of sea ice under carefully determined conditions;
(*b*) study of the geometry of the inter- and intra-crystalline structure of sea ice;
(*c*) maintenance of a continuous series of measurements of meteorological conditions, ice salinity, temperature profile, and growth rate;
(*d*) a phase diagram for the temperature dependence of the brine volume and presence of solid salts;
(*e*) a theory for the variation of the strength of warm sea ice as a function of temperature and salinity;
(*f*) theoretical and experimental values for the variation of the thermal and electrical properties of sea ice as a function of temperature and salinity;
(*g*) theoretical values for the variation of the density and thermal expansion of sea ice with temperature and salinity;
(*h*) seismic methods of determining ice thickness and elastic characteristics;
(*i*) statistical studies of the lateral variation of the salinity of different types of young sea ice; and
(*j*) an increase in the knowledge of problems associated with the movement of vehicles and aircraft across sea ice in marginal conditions.

The main scientific personnel on the project were: D. L. Anderson, geophysicist, AFCRC; A. Assur, physicist, SIPRE; T. R. Butkovich, physicist, SIPRE; O. S. Lee, oceanographer, NHO; P. Pomeroy, geophysicist, AFCRC; and W. F. Weeks, geologist, AFCRC. Papers that are wholly or in part based upon this work are listed in the bibliography.

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PALAEOMAGNETIC INVESTIGATION OF ARCTIC ROCKS AT CAMBRIDGE

BY W. B. HARLAND*

[*MS. received 8 May 1959.*]

Recent advances in rock magnetism have established the value of measuring the direction of the remanent magnetism of many kinds of rock. Provided certain conditions are satisfied, individual measurements relate to magnetic pole positions and sufficient measurements give a mean position which may indicate the geographical pole. Thus from determinations of a number of samples of rock from a geological formation, with suitable corrections, the latitude and geographical orientation of the rock at the time when it assumed its magnetic field may be postulated. This restricts and, in due course, may define palaeogeographical reconstructions and so serve to identify movements of the crust in relation to each other and to the poles. Results so far obtained[1] show that averaged pole positions from successive rocks, ranging through many hundreds of millions of years in the same relatively undisturbed areas, lie on curves extending through many tens of degrees of arc. Moreover, similar curves, uniting near the present poles today but diverging considerably when traced backwards in time, derive from different continents, suggesting that both relative continental movements and polar wandering must be taken seriously. From the pattern of pole positions from dated rocks it may be possible to correlate rocks of unknown age (e.g. unfossiliferous and Pre-Cambrian rocks), and solve some petrogenetic problems.

It is still desirable to investigate datable rocks distributed as widely as possible in space and time. Hitherto, with the exception of notable studies of Icelandic rocks by Hospers and others, no results have been published from the Arctic. The significance of this area from a palaeomagnetic point of view was realized some time ago and it was decided in Cambridge to combine such studies with various geological investigations in Spitsbergen. These had already led to an interest in correlating Spitsbergen and Greenland rocks and structures which was strongly reciprocated by Dr Lauge Koch from his work in east Greenland, and he gave D. E. T. Bidgood and myself an opportunity on his 1957 expedition to make a preliminary collection. In 1958 the main emphasis of the field work was in Spitsbergen, where it is planned to resume work in 1959 and also to collect from Bjørnøya.

Laboratory facilities were generously provided by B. C. Browne at the Department of Geodesy and Geophysics, under the direction of J. C. Belshé. As work increased an additional self-contained laboratory was set up in the Sedgwick Museum. Cambridge. The Department of Scientific and Industrial Research assisted financially in both field and laboratory work. Results will be

* Sedgwick Museum, Cambridge.

Table

Collector(s)	Localities	Approximate age	Formation	No. of samples
Oxford and Cambridge Spitsbergen Expedition, 1951: Leaders, J. M. Hartog and W. B. Harland				
Reference: *Polar Record*, Vol. 6, No. 46, 1953, p. 800–3				
M. F. W. Holland	Hinlopenstretet and S.W. Nordaustlandet	Post-Carboniferous	Dolerite sills	9
	Daudmannsodden	Post-Carboniferous	Dolerite sills	5
M. H. P. Bott and M. B. Bayly	Chydeniusbreen	Post-Carboniferous	Dolerite sills	3
British Sherborne/Cambridge Spitsbergen Expedition, 1954: Leader, G. T. Wright				
H. J. Goodhart	Sassenfjorden	Post-Trias	Dolerite sills	4
	Malte Brunfjellet	Late Pre-Cambrian	M. Hecla Hoek sandstones	1
Cambridge Spitsbergen Expedition, 1957: Leader, P. F. Friend				
Reference: *Polar Record*, Vol. 9, No. 59, 1958, p. 141				
P. F. Friend	Vestfjorden	L. Devonian	Wood Bay Series	2
	Billefjorden	L. Carboniferous	U. Billefjorden sandstones	2
	Adventdalen	? L. Tertiary	—	2
M. C. Allderidge	Vestfjorden	L.-M. Devonian	—	3
C. B. Wilson, 1957 (*Spitsbergen*)				
Reference: *Polar Record*, Vol. 9, No. 59, 1958, p. 142				
—	Festningen	U. Jurassic	—	3
—	Festningen	L. Cretaceous	—	2
—	Festningen	U. Trias	—	2
—	Festningen	L. Trias	—	2
—	Festningen	Permo-Carboniferous	—	2
—	E. Veteranen	Post-Carboniferous	Dolerite sill	1
—	E. of Raudfjorden	? Downtonian	? Red Bay Series	1
—	W. and N.W. Wijdefjorden	? Cretaceous/Tertiary	Lava	2
—	W. and N.W. Wijdefjorden	M. Devonian	{Wijde Bay Series {Grey Hoek Series	5 2
—	W. and N.W. Wijdefjorden	L. Devonian	Wood Bay Series	1
Queen's University Spitsbergen Expedition, 1957: Leader, W. Schwarzacher				
Reference: *Polar Record*, Vol. 9, No. 59, 1958, p. 141				
W. Schwarzacher	E. Ekmanfjorden	L. Devonian	Wood Bay Series	1
	W. Dicksonfjorden	—	Dolerite sill	1

Table (*cont.*)

Collector(s)	Localities	Approximate age	Formation	No. of samples
Danish East Greenland Expedition, 1957: Leader, Lauge Koch				
W. B. Harland and D. E. T. Bidgood	Ella Ø	M. Devonian	Basal conglomerate	2
	Ella Ø	L. Ordovician	? Cass Fjord or Kapp Weber Formation	3
	Ella Ø	L. Cambrian	Bastion and Klöftelv Formations	9
	Ella Ø	Late Pre-Cambrian	? Spiral Creek Formation	4
	Ella Ø	Late Pre-Cambrian	Canyon Formation	3
	Ella Ø	Late Pre-Cambrian	U. Tillite	15
	Ella Ø	Late Pre-Cambrian	Inter Tillite Beds	2
	Ella Ø	Late Pre-Cambrian	L. Tillite	9
	Ella Ø	Late Pre-Cambrian	Limestone Dolomite Series	9
	Gauss Halvö Kap Franklin	U. Devonian	Mt Celsius Series	5
	Gauss Halvö Kap Franklin	M. Devonian	Margrethedal Series	4
	Gauss Halvö Kap Franklin	M. Devonian	Kap Franklin Series	3
	Gauss Halvö Kap Franklin	M. Devonian	Vildal Series	4
	Gauss Halvö Gastisdal	? Cretaceous/Tertiary	Basalt sills	6
	Gauss Halvö Gastisdal	? Cretaceous	Sandstone	2
	Gauss Halvö Gastisdal	L. Trias	Eo-Triassic sandstone	3
	Gauss Halvö Gastisdal	? U. Permian	Sandstone	9
	Gauss Halvö Gastisdal	? L. Namurian	Sandstone	12
	Gauss Halvö Gastisdal	M. Devonian	Sandstones and greenstones	13
	Gauss Halvö Gastisdal	? Devonian	Granite	4
	Gunnar Andersson's Land	U. Devonian	Kap Graah Series	10
	Gunnar Andersson's Land	U. Devonian	Kap Költhov Series sandstones and basalts	18
	Gunnar Andersson's Land	? Devonian	Rhyolite	4
	Ymers Ø	U. Devonian	Mt Celsius Series	14
	Ymers Ø	U. Devonian	Kap Graah Series sandstone and basalt	6
	Ymers Ø	U. Devonian	Kap Költhov Series basalt	7
	Ymers Ø	L. Carboniferous	—	8
	Ruth Ø	Late Pre-Cambrian	L. Multicoloured Series	10
	Ruth Ø	Late Pre-Cambrian	U. Quartzite Series	6
	Kap Biot	Trias	Kap Biot formation	33
	Kap Biot	L. Trias	Continental Series	11
	Geographical Soc. Ø	M. Devonian	Horizon 4/5	6
	Alpefjord	Late Pre-Cambrian	Alpefjord Series	14
	Alpefjord	? Late Pre-Cambrian	Greenstone dyke	3
	Mesters Vig	Cretaceous/Tertiary	Dolerite sill	7
	Mesters Vig	"Eo-Trias"	"Ophiceras Beds"	4
	Mesters Vig	L. Permian	Domkirken Series	4

Collector(s)	Localities	Approximate age	Formation	No. of samples
British Expedition to North West Greenland, 1957: Leader, J. W. Cowie				
Reference: *Polar Record*, Vol. 9, No. 61, 1959, p. 336				
J. W. Cowie	Ffoulkes Fjord	? Pre-Cambrian	Basic sill in Thule Formation	5
	Gothåab	? Pre-Cambrian	Basic dyke	1
North West Spitsbergen Expedition, 1958: Leader, E. L. Lewis				
D. E. T. Bidgood with E. L. Lewis, A. W. Williamson, B. R. Sparke, P. A. Roberts and E. B. Davies	Festningen	? Palaeocene	Siltstone	3
	Festningen	Post-Trias	Dolerite	4
	Festningen	Cretaceous	Four horizons	24
	Festningen	Jurassic	—	10
	Festningen	Jurassic/Trias	—	6
	Festningen	U. Trias	Sandstone	4
	Festningen	M. Trias	Flagstones	4
	Festningen	Post-Trias	Dolerite/Trias contact	6
	Festningen	Eo-Trias	Siltstones	8
	Festningen	Permo-Carboniferous	—	17
	Anservika	Post-Trias	Dolerite sill	4
	Anservika	L. Carboniferous	Billefjorden sandstones	10
	Veteranen	Late Pre-Cambrian	U. Glasgowbreen Greywackes	4 + ?11
	Veteranen	Late Pre-Cambrian	U. Glasgowbreen Quartzites	3
	Veteranen	Late Pre-Cambrian	Cavendishryggen Greywackes	8 + ?6
	Veteranen	Late Pre-Cambrian	Cavendishryggen Quartzites	8
	Veteranen	Late Pre-Cambrian	Cavendishryggen Limestones	6
	Veteranen	Late Pre-Cambrian	Galoistoppen Beds	14
	Veteranen	Late Pre-Cambrian	Veteranen Quartzites	11
	Veteranen	Late Pre-Cambrian	Veteranen Limestones	4
	Veteranen	Late Pre-Cambrian	Planetfjella Schists	6
	Wilsonbreen	Late Pre-Cambrian	U. Polarisbreen Shales	6
	Wilsonbreen	Late Pre-Cambrian	Polarisbreen Tillite Formation	30
	Wilsonbreen	Late Pre-Cambrian	L. Polarisbreen Shale Formation	8
	Wilsonbreen	Late Pre-Cambrian	Svanbergfjellet Beds	4
	Wilsonbreen	Late Pre-Cambrian	U. Grusdievbreen Limestones	10
	Snøfrua	Late Pre-Cambrian	Fulmarberget Shales	14
	Snøfrua	Late Pre-Cambrian	Enpiggen Beds	16
	Ebbadalen	L. Carboniferous	Billefjorden sandstones	13
	Adolfbukta N. shore	U.M. Carboniferous	Passage Beds	7
	Nordfjorden	Post-Trias	Dolerite sill	4
	Nordfjorden	Eo-Trias	Siltstones	4
	Nordfjorden	M. Trias	Siltstones	4
	Kapp Thordsen	Post Trias	Dolerite (dyke, sill and contact)	22

Table (*cont.*)

Collector(s)	Localities	Approximate age	Formation	No. of samples
Cambridge Spitsbergen Expedition, 1958: Leader, P. F. Friend				
D. Benton	N. Adolfbukta	L. Carboniferous	Billefjorden sandstones	4
P. F. Friend	Andrée Land	M. Devonian	U. Grey Hoek Series	1
	Andrée Land	?	Basalt	1
M. Fuller	Longyearbyen	Palaeocene/Eocene	Three horizons	15
	Longyearbyen	Cretaceous	—	3
	Jäderindalen	L. Devonian	Wood Bay Series	2
	Odellfjellet	L. Carboniferous	Billefjorden sandstones	4
	Adolfbukta, Petuniabukta	L. Carboniferous	Billefjorden sandstones	10
	Adolfbukta, Petuniabukta	Pre-Cambrian	Lower Hecla Hoek Formation	6
	Krosspyntdalen	L. Devonian	Wood Bay Series	2 + ?1
	Krosspynten	? Cretaceous/Tertiary	Dykes and baked margins	22
	Krosspynten	Devonian	—	1
	Tavlefjellet	? Cretaceous/Tertiary	Basalt	3
	Purpurdalen	M. Devonian	Grey Hoek Series	4
	Purpurdalen	L. Devonian	Wood Bay Series	7
	Forkdalen and Andredalen	M. Devonian	Wijde Bay and ? Grey Hoek Series	9
	Forkdalen and Andredalen	L. Devonian	Wood Bay Series	3
	S. of Kapp Petermann	? Cretaceous/Tertiary	Dyke and baked margin,	2
	S. of Kapp Petermann	L. Devonian	Wood Bay Series	1
	W. Billefjorden	L. Devonian	Wood Bay Series	4
	Mimerdalen	M. Devonian	—	7
	Mimerdalen	L. Devonian	Wood Bay Series	5
D. Gobbett	Ebbadalen	L. Carboniferous	Billefjorden sandstones	2
	Ragnardalen	L. Carboniferous	Billefjorden sandstones	4
P. Simpson	Ebbadalen	L. Carboniferous	Billefjorden sandstones	2
J. C. Taylor	Forkdalen	—	Basic dyke	1
Birmingham and Exeter Spitsbergen Expedition, 1958: Leaders, D. L. Dineley and P. A. Garrett				
D. L. Dineley	Ekmanfjorden	L. Devonian	Wood Bay Series	6
Cambridge Zoological Expedition, 1958: Leader, C. Plowright				
J. L. Cutbill	Nordaustlandet, Wahlenberg-fjorden, Gyldénoyane	—	Dolerite sill	3

published as convenient groups of rocks are measured; the first results may be expected in *Meddelelser om Grønland.* Results already amply justify these collections.

The table gives the stratigraphical and geographical distribution of the collections to date, and the collectors and expeditions which were responsible. At the same time supplementary collections were made in Great Britain and Norway for comparison. This opportunity is taken of thanking those who have contributed specimens to the collection, each being about the size of a half brick or larger and accurately oriented. Hitherto the work has been in the nature of a reconnaissance and further studies must be made in selected localities. However, an integrated programme allows a large collection to result from the steady addition of small numbers of specimens collected in the course of geological work, and it is hoped that this article will encourage further collections and still wider co-operation in this field. Notes on collecting methods are available from the Sedgwick Museum, Cambridge.

Reference

[1] Irving, E. Palaeomagnetic pole positions: a survey and analysis. *Journal of Geophysics*, Vol. 2, No. 1, 1959, p. 51–79.

RECIPES FOR AN ANTARCTIC COOK

BY GERALD T. CUTLAND

[The following recipes have been summarized from notes prepared at the Falkland Islands Dependencies Survey station at the Argentine Islands, where the writer was cook in 1956–57. His skill and initiative deserve acclaim amongst a wider circle. We therefore publish a number of his recipes based on local raw materials.—Ed.]

The meat of young shags, seals and penguins makes excellent eating but, in the natural state, it is rather too highly flavoured to be palatable. It should therefore be washed thoroughly and hung in the fresh air for a few days, or in the case of shags for a couple of weeks, before cooking. It is further improved by blanching; this consists of putting the meat in cold water, bringing the water to the boil, then removing the meat and washing it.

Remove all blubber before cooking. Always use beef suet in cooking these meats.

Seal

Roast seal

Seal meat
4 oz. beef suet
Bacon
Reconstituted onions
"Bisto", salt and pepper

Season joint well and place in a baking dish. Cover with nuts of beef suet and slices of bacon and sprinkle liberally with reconstituted onions. Bake in a hot oven until outside is crisp, then place in moderate oven until cooked. Gravy is made by mixing a little "Bisto", salt and pepper with the juices and adding water until the required consistency is reached.

Roulades of seal

Seal meat
Tomatoes
½ cup reconstituted onions
½ cup reconstituted turnips
½ cup peas
4 oz. beef suet
Bacon
2 tablespoons vinegar
1 tablespoon flour
Parsley or mixed herbs
"Bovril", salt, pepper, water

Cut meat into rectangles and season. Lay rasher of bacon on each piece and sprinkle with parsley or mixed herbs. Roll up and tie with cotton thread. Fry rolls lightly in fat until brown all over, then place in a baking dish. Fry onions, turnips, peas and tomatoes, and add to meat. Cook flour in fat until brown, then add water, 1 tablespoon "Bovril", vinegar, salt and pepper. Bring mixture to the boil and pour over the meat, almost covering it. Cook in moderate oven for about 2 hours. Remove thread and serve.

Braised seal

Seal meat
¼ cup reconstituted carrot
½ cup each reconstituted onion, turnip and peas
1 tablespoon each "Bovril", flour and water
4 oz. beef suet
6 tomatoes
Salt and pepper

Fry vegetables in fat until brown, then remove from saucepan. Cook flour in fat until brown, add water, "Bovril", salt and pepper stirring continuously. Return vegetables to the saucepan and place meat on top. Add gravy and simmer for 2 or 3 hours. Half an hour before required remove lid of saucepan to enable meat to brown and crisp on top. This dish can also be cooked in a casserole in a moderate oven.

Casserole of seal

Seal meat
½ tin each carrots, peas
½ cup each reconstituted turnips, onions
4 oz. beef suet
1 tablespoon each "Bovril" and flour
Water, Worcester Sauce, Tomato Sauce

Cut meat into small pieces and season. Dip in flour, and part-fry in suet with onion; when brown on each side place in casserole in alternate layers with vegetables. Cook flour in fat until brown; add water, "Bovril", "Worcester" and Tomato Sauces, pepper and salt slowly, stirring continuously, until gravy reaches required consistency. Bring to the boil and pour over meat and vegetables. Cook in moderate oven for about 2 hours.

Tournedos of seal

Seal meat
Butter and seasoning
Garnish:
  5 celery hearts
Sauce:
  4 reconstituted eggs
  ½ teaspoon mustard
  1 tablespoon reconstituted onion
Slices of bread crisply fried in butter
Peas
½ gill vinegar
¼ lb. butter
Salt and pepper

Cut meat into round pieces about 1 in. thick, season well, and fry quickly in butter.

To prepare garnish. Drain and rinse celery hearts and heat for a few minutes in butter; season.

To prepare sauce. Put vinegar in small saucepan and add onions; boil until reduced by about half, then strain. Melt butter without boiling. Add some of the butter and the eggs to the vinegar and mix quickly with a wire whisk. Remove saucepan from fire and add the rest of the butter slowly, whisking continuously to prevent curdling. Then add mustard and seasoning. The sauce must be prepared shortly before use, if left to stand it thickens and becomes spoilt.

Place each piece of meat on a slice of fried bread with a celery heart and peas. Cover with sauce and sprinkle with parsley.

Tournedos of seal portugaise

Seal meat
Garnish: Tinned tomatoes, about 2 per person, tinned peas
Slices of fried bread
Sauce: 2 oz. butter
1 tablespoon flour
Butter and seasoning
Tomato Sauce
Milk, salt, pepper

Cut meat into round pieces about 1 in. thick, season and fry quickly in butter.

To prepare garnish. Heat tomatoes and peas in butter for a few minutes.

To prepare sauce: Melt butter in small saucepan and bring to the boil. Add flour and cook for a few minutes, stirring continuously. Add milk slowly with saucepan away from heat, stirring continuously until sauce reaches required thickness. Season, and flavour with Tomato Sauce. Return to stove and re-heat, but do not boil.

Place each piece of meat on a slice of fried bread and garnish with tomatoes and peas. Top each tournedos with Tomato Sauce, and pour remainder of sauce round the tournedos.

Roast seal heart

Seal heart
Reconstituted onions
Salt and pepper
4 oz. beef suet
Sage
"Bisto"

Place heart in baking dish and sprinkle with onions and nuts of suet. Season. Cover with greaseproof paper and roast in a moderate oven for about 2 hours. Hearts may be stuffed with sage and onions before cooking, or stuffing may be cooked separately. Gravy is made from meat juices flavoured with a little "Bisto".

Braised seal heart

Seal hearts
6 tomatoes
4 oz. beef suet
Water or stock
½ cup each reconstituted onion, turnip, peas
¼ cup reconstituted carrot
1 tablespoon each "Bovril", flour
Salt, pepper

Ensure that all blood is washed from hearts and soak them in salt water for 2 or 3 hours. Fry vegetables until brown. Remove vegetables from pan. Cook flour in remaining fat until brown; add water, stock, "Bovril", salt and pepper, stirring continuously to prevent lumps forming, until gravy reaches required thickness. Return vegetables to stewpan and place hearts on top, almost covering with gravy. Cover and simmer for 2 or 3 hours.

Slice hearts for serving.

Savoury seal hearts

Hearts
Parsley, sage and seasoning
Reconstituted onions
Bacon
Breadcrumbs or rice
Clarified butter

Cover bottom of a casserole with thin layer of clarified butter. Cut hearts into thick slices. Make a stuffing by mincing breadcrumbs, or boiled rice, with

sage, onions, parsley and butter. Cover the bottom of the casserole with a layer of sliced heart, then a layer of stuffing, then a layer of fat bacon; continue this pattern until it is full. Pour clarified butter on top, cover with greaseproof paper, and close lid tightly. Bake in moderate oven for at least 2 hours.

Seal hamburgers

1 lb. meat	½ cup reconstituted onions
4 tomatoes	2 reconstituted eggs
2 teaspooons each dried sage and parsley	Salt and pepper
2 tablespoons each "Worcester" and Tomato Sauce	

Mince, or chop, meat finely and mix well with other ingredients. Form into patties and put in greased baking dish, bake in moderate oven for 1 hour. These may also be served fried, after being coated with flour.

Fried seal liver

Thin slices of liver	Clarified butter
Bacon	Flour
Parsley, fried onions, seasoning	Milk

Soak slices of liver in milk for 2 hours. Dry and flour well on both sides. Heat clarified butter in frying pan until it is very hot (do not burn). Cook slices of liver for 30 sec. each side in hot butter, then remove frying pan from main heat and cook liver slowly until ready, adding a pinch of parsley to the fat. Remove from frying pan and sprinkle with parsley. Cook bacon and onions ready to serve with liver.

Seal faggots

1 lb. liver	½ tin fat bacon
½ cup reconstituted onions	1 teaspoon mixed herbs
Thick slice of bread	Salt and pepper

Cut up liver and bacon, mix with other ingredients. Place in greased baking dish and bake in medium oven for about 1 hour.

Seal brains

The meat should be a milkish white colour, apart from the veins visible on the surface. Wash thoroughly in salt water removing loose skin and blood, then soak in fresh water for an hour, changing the water two or three times. Place in lined saucepan and cover with water, adding enough salt and vinegar to flavour the water, bring to the boil, and boil slowly for 15 minutes. Dry the brain on a cloth ready for cooking.

Fried seal brains

2 brains, prepared as above	Butter
Flour, salt, pepper	Egg, breadcrumbs

Cut brains in thick slices and season. Coat lightly with flour, dip in beaten egg, then in breadcrumbs, and fry in butter until brown.

Seal brains au gratin

2 brains, prepared as above
½ pt. White Sauce
Pepper, salt, butter
2 tablespoons evaporated milk
Grated cheese

Cut brains into moderate sized pieces. Heat sauce in saucepan, stir in a little grated cheese and add brain, onion, salt and pepper. Pour mixture into greased casserole, sprinkle with breadcrumbs and cover with grated cheese, scatter nuts of butter on cheese and brown quickly in oven.

The mixture may be served as a Savoury by placing on hot buttered toast and topping with Tomato Sauce.

Seal brain fritters

2 brains, prepared as above
4 reconstituted eggs
2 tablespoons butter
Flour, salt, pepper, mixed herbs
Beef suet

Mash brains until soft and light. Make a smooth batter with eggs and flour, beating well. Add brains, melted butter and pinch of mixed herbs, salt and pepper and mix well. Drop tablespoons of the mixture into boiling fat, and fry until golden brown. Drain well before serving.

Savoury seal brains on toast

1 brain, prepared as above
3 reconstituted eggs
Grated cheese
Toast
1 dessertspoon Tomato Sauce
3 oz. butter
Salt, pepper, grated nutmeg

Chop brains into small pieces and mix with eggs, Tomato Sauce and nutmeg. Melt butter in pan and add mixture, cook for a minute or two, stirring continuously. Serve on hot buttered toast sprinkled with grated cheese.

Shag

General. Birds should be carefully skinned, not plucked. The best place to begin skinning is just below the bottom of the breast bone. One bird provides enough meat for five or six persons.

Roast shag

Shag
Reconstituted onions
Bacon
Beef suet
½ pint milk
Flour
Orange essence
"Bisto", salt, pepper

Place in roasting dish, season, sprinkle with reconstituted onions and place nuts of suet and rashers of bacon over breast. Cook in moderate oven for about 2 hours, basting frequently. Serve with Orange Sauce and gravy.

Orange Sauce: Mix 1 tablespoon flour and a little milk into a smooth paste. Boil ½ pint milk and stir into the mixture. Add Orange essence to taste and

bring to boil again, add more milk and flour until proper consistency is reached.

Gravy: Mix a little "Bisto" and water and stir into cooking fat; bring to boil and add flour until required thickness is reached.

Shag Maryland

Jointed bird	White breadcrumbs
Reconstituted eggs	Beef suet
1 tablespoon flour	Tomatoes
2 oz. butter	Tinned peas and carrots
½ pint milk	

Dip joints in reconstituted egg and cover with breadcrumbs. Place in baking dish with a little suet and cook in moderate oven, basting frequently, for about 2 hours. Rub tomatoes through a sieve to make a purée. Melt butter in a saucepan, add a tablespoon flour and cook slowly for about 1 minute, stirring continuously, until flour is brown. Remove from stove and stir in ½ pint milk and tomato purée, season, heat, but do not boil. Put this sauce over meat, and garnish with tinned peas and carrots. Tomato soup may be used for the sauce.

Spanish Paella with shag

1 shag	½ lb. rice
6 sliced tomatoes	½ cup reconstituted French Beans
1 tin crawfish	½ cup tinned peas
1 tin "Trim" (tinned meat)	2 tablespoons butter
2 or 3 sausages	Reconstituted onions

Remove flesh and cut into small cubes, fry in butter. Add onions and rice. Mix and cook for about 2 minutes. Add 1 cup boiling water and the beans, peas, and tomatoes. Cube the crawfish, "Trim" and sausages and add to mixture. Cook until rice becomes tender and all water is absorbed.

Casserole of shag—as with seal meat base.

Fricassee of shag

1 jointed shag	¼ lb. butter
½ cup reconstituted onions	2 pints milk
2 oz. flour	6 rashers bacon
¼ lb. lean ham	Salt and pepper
Beef suet	

Fry onions and meat in fat and remove from frying pan. Stir flour into fat and cook for a few minutes; add milk slowly, stirring continuously, and bring to boil. Return meat and onions, together with ham, to pan and simmer until meat is cooked. Roll and bake bacon until crisp. Place bacon rolls on meat and surround with sauce before serving.

Jugged shag

1 jointed shag	2 pints gravy
4 oz. beef suet	2 drops oil of cloves
2 oz. flour	1 teaspoon mixed herbs (in muslin bag)
½ cup reconstituted onions	4 glasses port wine
4 rashers bacon	

Lightly fry meat and bacon, then place in casserole. Cover with gravy and stir in flour mixed with a little water. Add onions, seasoning, herbs and oil of cloves. Cover, and cook in moderate oven for about 3 hours. Shortly before serving remove the herbs and stir in port wine.

Fried or grilled shag

1 jointed shag	Egg and breadcrumbs
Stock	Butter
Flour	

Stew meat slowly in stock until tender; drain, dry and cool. Coat with flour and roll in mixture of egg and breadcrumbs. Fry in butter, or dip in butter and grill. Serve with a sharp sauce.

Savoury shag hot pot

1 jointed shag	Bacon
1 tin potatoes	Onions
1 tablespoon turnip	Mixed herbs
2 pints stock	Butter
Seasoning	"Bovril"

Remove meat from bones. Place layer of sliced potato in casserole and cover with layer of meat, a pinch of mixed herbs, a little turnip, onion and seasoning. Cover with a layer of bacon. Repeat these layers until casserole is full, ending with a covering of potato. Mix a tablespoon of "Bovril" into stock and pour into the casserole—but do not cover the top layer of potato. Dot with butter, cover and cook in moderate oven for about 2 hours.

Penguin

General. Only the breast of the bird is used.

Roast penguin

Penguin breasts	Reconstituted onions
Butter	Flour
Beef suet	"Bisto", salt, pepper

Season well with salt and pepper and dip each piece in melted butter. Roll in flour and part-fry in beef suet. When each side is fairly crisp place it in a baking dish with the fat from the frying pan; sprinkle with some reconstituted onions and cook in a moderate oven. Gravy is made by stirring a teaspoon of flour into the hot cooking fat and cooking until brown, and adding "Bisto" with sufficient water or stock to make a thick gravy.

Tournedos of penguin Portugaise—as with seal meat base.
Braised penguin breast—as with seal meat base.
Casserole of penguin—as with seal meat base.

Escollops of penguin

Penguin breasts	Batter
Reconstituted onion	Flour
Salt and pepper	Beef suet
Milk	1 tin Mushroom Soup

Cut breasts in slices and soak in milk for about 2 hours. Dry, season and flour on both sides. Mix onion in batter. Roll meat in batter and fry in deep fat. Pour tin Mushroom Soup over meat as sauce.

Roulades of penguin—as with seal meat base.

Sauté of penguin

Penguin breasts	1 cup reconstituted onions
1 tin tomatoes	4 oz. butter
1 tin Tomato Soup	Mixed herbs, salt, pepper

Cut breasts into small pieces, fry in butter until brown, and add onion. Drain tomatoes, mash half to a purée and stir into meat and onions, add salt, pepper, mixed herbs and Tomato Soup; simmer until meat is tender.

Fried penguin breasts

Penguin breasts	Beef suet
Flour	Salt and pepper

Cut breasts into small pieces and season. Roll in flour and fry until crisp.

FIELD WORK

SOVIET DRIFTING STATIONS IN THE ARCTIC OCEAN, 1958–59

[From *Vodnyy Transport* [*Water Transport*], 23 December 1958, 21 February, 18 March, 19 March, 5 April, 21 April, and 1 May 1959; Moscow Radio, 30 April 1959. Notes on the course of earlier drifting stations were published in the *Polar Record*, Vol. 8, No. 57, 1957, p. 521 and previous numbers.]

Stations SP-6 and SP-7 drifted during the year on roughly parallel courses, the first passing about 200 miles on the Siberian side of the North Pole, and the second about the same distance on the American side. There was severe cracking of the floe on which SP-7 stood in December 1958, and this necessitated moving some buildings, but the station was able to continue its work. At SP-6 divers with aqua-lungs were employed to fix a current recorder on the under side of a floe near the station.

The annual relief expedition, named "Sever-11" because it was the eleventh in the series, was led by M. M. Nikitin, with P. P. Moskalenko in charge of flying. It was in the field from March to May 1959. SP-7 was evacuated because it was approaching the Greenland coast. SP-6 was relieved in mid-April by a party under V. S. Antonov. This station is expected to drift out of the Arctic Ocean between Spitsbergen and Greenland during the winter of 1959–60. A new station, SP-8, under V. M. Rogachev, was set up on 27 and 28 April on a floe 3 m. thick in lat. 76° 11′ N., long. 164° 24′ W., some 800 km. north-east of Ostrov Vrangelya.

ARCTIC UNIT OF FISHERIES RESEARCH BOARD OF CANADA: ACTIVITIES IN 1958

[Summarized from *Annual Report of Fisheries Research Board of Canada*, 1957–58, Ottawa, 1958, p. 115–22.]

During the period of 1947–54 fisheries investigations in Canadian Arctic waters were carried out by Dartmouth College on behalf of the Fisheries Research Board of Canada. The scope of the investigations became too wide for part-time control, and, in 1955, the Arctic Unit of the Fisheries Research Board was established in Ottawa.[1] H. D. Fisher is Director, and the unit includes six other scientists: A. S. Bursa, E. H. Grainger, J. G. Hunter, I. A. McLaren, A. W. Mansfield and D. E. Sergeant, also a librarian, five technicians and three clerical staff. Close liaison is maintained with both the Arctic Institute of North America and McGill University, in whose buildings the Unit is housed. There are, at present, no permanent field stations and work is carried out from seasonal camps.

The work of the Arctic Unit is organized in three main divisions: fisheries investigations, marine mammal investigations and biological oceanography.

Fisheries investigations

These are mainly surveys into the relative abundance, life history, seasonal movements and use of various species. This work is of practical application in the search for ways of diverting hunting pressure from the rapidly decreasing stocks of caribou in the Canadian Arctic.

During 1958 these surveys were carried out at Firth River, Yukon Territory, at Mackenzie River and Coppermine River, Northwest Territories, and on Rowley Island in Foxe Basin. Arctic Char, whitefish, crooked-back whitefish and lake

[1] *Polar Record*, Vol. 8, No. 54, 1956, p. 255.

The heavy lines show the course of Soviet drifting stations SP-6, SP-7 and SP-8. Depth contours are taken from Soviet sources correct to 1956.

herring are the commonest fish. Whitefish in Coppermine River displayed a unique growth pattern; growth being steady until the 11th year, followed by a sudden increase for 2 or 3 years, and very little more after that, though the fish may live for 20 years. A party, working from the Unit's ship *Calanus* at Rowley Island, caught, measured and examined 1500 specimens of Arctic Char during the season.

Marine mammal investigations

Studies of marine mammals extended south on the Atlantic coast to cover the fisheries for pilot whales off Newfoundland, and the Harp Seal grounds in the Gulf of St Lawrence and off the east coast of Labrador and Newfoundland. In spite of intensive fishing the number of pilot whales show no signs of diminishing. In the Arctic work was concentrated during the past year on Walrus and Ringed Seal, pinnipeds of considerable economic importance in the northern marine living economy.

Walrus investigations. Continued research on cementum layers on tusks and molariform teeth of females indicates reliable ageing up to 10 or 12 years. Successful ageing for males was reported upon in 1956. Sexual maturity of the female is probably attained at 7 years, with full breeding maturity in the following year.

It has been possible to demonstrate that adult male Walrus from northern Foxe Basin are, on the average, slightly larger than those from Southampton Island. This, together with limited observations on distribution, suggests that the populations are relatively isolated. Counts of Walrus from *Calanus* indicate a population of about 3000 for northern Hudson Bay. This agrees with an air survey of hauling-out grounds in this area in 1954 by the Canadian Wildlife Service. Present knowledge of stock size, mortality and reproductive potential suggests that the northern Hudson Bay stock is well utilized. No increase in annual take is advisable without further careful air survey and collection of samples for age composition. It has not yet been possible to estimate the size of the northern Foxe Basin stock. Reproduction data indicate that this stock has a greater reproductive potential and is immune from over-hunting at the present level of utilization. A full report on the biology of the Walrus has been completed.

Ringed Seal investigations. Interest in organized native exploitation of the pinniped resources in the Arctic by the Department of Northern Affairs and National Resources led during the year to studies on populations, availability and economics of the Ringed Seal, the most important seal in the Arctic. These form a basis both for rational utilization, and regulation by the Department of Fisheries. Biological studies have been completed and are published or in press.

The distribution and abundance of Ringed Seals is governed by the amount and quality of fast ice on the coastlines inhabited by this seal, and indirectly by the complexity of the coastline. Using actual careful counts made of seals on known areas of ice of representative types and coastlines as a basis, figures have been derived for the numbers of Ringed Seals inhabiting coastlines throughout the eastern Canadian Arctic, from planimetric measurements of fast ice areas on topographic sheets. At present this has been confined to the eastern Arctic between Pond Inlet on Baffin Island, and Port Harrison in eastern Hudson Bay. Seal populations range from an estimated 74,900 in the Home Bay area, Baffin Island, to 5000 for the south-west coast of Hudson Strait, with maximum sustainable annual yields (based on reproductive rates, sex ratios, total mortality and hunting mortality) of 5990 and 400, respectively. The most important area economically at present is Frobisher Bay, with an estimated stock of 52,700 seals and a potential maximum sustainable yield of 4210.

Indices of availability have been constructed, based on population figures and

areas of fast ice and water in which these populations are dispersed. Utilizing the known results of 40 summer hunts, 16 floe-edge hunts and 19 fast ice hunts in widely separated Arctic localities, these indices have been converted to potential catch per unit of effort, to serve as a guide in development of hunting projects. In addition, since there is a large and important geographical variation in size, tables have been drawn up setting out weights of meat per seal in various seasons and localities. Seasonal variations in salinity of sea water and in blubber amount and specific gravity have been studied to produce tables setting out a loss factor from sinking, in terms of the time of year and latitude. Hunting methods are being surveyed to clarify merits and drawbacks.

Biological oceanography

Observations on water temperature, salinity, dissolved oxygen and inorganic phosphate, and collections of plankton were made between late May and September in Frustration Bay, Rowley Island. Depths of stations, taken for the most part through ice cover, were from 9 to 34 m.

A complete annual cycle of oceanography was followed at Igloolik from September 1955 to September 1956; analysis of the physical and plankton data was carried out in 1957. This shortly will be ready for publication.

Work was begun on coarse net plankton from collections made from the *Calanus* in northern Foxe Basin, mainly in August and September, in the period 1955–57 inclusive. The stations were spread over the area north of Rowley Island.

Data on ice, temperature, light, oxygen and phosphates associated with the plankton studies outlined above are being tied in with phytoplankton studies, and a report on the annual cycle of phytoplankton at Igloolik has been prepared. Ice constitutes an important limiting factor for plankton life in the Arctic. Late summer populations are trapped by freezing, and both coloured and colourless ice stratification results. Some organisms recover after the melts and are probably capable of reproducing. It is hoped to study the biology of ice in some detail in future.

In addition to the Igloolik study, work on quantitative phytoplankton collections in Foxe Basin by H.M.C.S. *Labrador* and *Calanus* was begun. An attempt is being made to apply methods which will allow estimation of production by means of chlorophyll analysis, and by numerical counts with the Utermöhl microscope. A taxonomic study of thecate dinoflagellates from earlier *Calanus* expeditions, beginning with Frobisher Bay collections, is underway. Some attention is being paid to taxonomic and biological studies, in plankton and cultures, of the dinoflagellate group responsible for such catastrophic phenomena as "red-tide". These studies are expected to be published in the coming year.

Studies were continued at Ogak Lake at the head of Ney Harbour, Frobisher Bay.

VICTORIA UNIVERSITY OF WELLINGTON ANTARCTIC EXPEDITION, 1958–59

[Summarized from information supplied by the Ross Dependency Research Committee, New Zealand.]

During the southern summer of 1958–59 a four man expedition from Victoria University, Wellington, New Zealand, worked a dry valley at the foot of Wright Glacier, Victoria Land. The party consisted of C. Bull, physicist (leader); R. E. Barwick, zoologist; and B. C. McKelvey and P. N. Webb, geologists. They were transported by United States aircraft to McMurdo Sound on 15 November 1958, and thence by helicopter to their destination. After seven weeks in the field they returned to New Zealand in H.M.N.Z.S. *Endeavour* on 16 February 1959. The expedition was financed

by the Council of Victoria University and the New Zealand University Research Grants Commission.

MacKelvey and Webb continued the geological mapping which they had begun the previous summer, and concentrated on a 40-mile representative section across the valley. The main rock boundaries across the valley are a granite metamorphic complex exposed for 35 miles. The complex is intruded by at least two phases of dyke injection. The Beacon sandstone/granite contact was examined over a wide area. The total area surveyed extending north and south of the dry valley, covers about 1000 sq. miles. Collections of igneous and sedimentary rock samples were made for palaeomagnetic studies.

Triangulation and topographical surveying was carried out from ten control points to connect with the work done by the New Zealand Geological and Survey Expedition, 1957–58, and the Trans-Antarctic Expedition, 1955–58.

A gravity traverse was carried for 50 miles inland to within 4 miles of the polar plateau from stations established by the New Zealand I.G.Y. parties at Marble Point and Scott Base.

Collections of zoological, botanical and biological interest were made in continuation of work begun during the previous season. Bodies of seals were discovered up to 45 miles inland, and of penguins up to 40 miles.

Some meteorological work was carried out at the foot of Wright Glacier on behalf of the New Zealand Meteorological Office and the observations showed little correlation with those made in the Marble Point area. There are a number of small interconnecting lakes in the valley whose water supply is from melting snow in summer. There is believed to be no outflow from the lowest lake yet they all appear to be stable in size during the summer. An attempt was made to estimate the mass balance of one lake by measuring inflow, rate of rise and evaporation.

NEW ZEALAND GEOLOGICAL AND SURVEY EXPEDITION, ROSS DEPENDENCY, 1958–59

[Summarized from information supplied by the Ross Dependency Research Committee.]

This expedition was organized by the Geological Survey Division of the Department of Scientific and Industrial Research (D.S.I.R.) and left New Zealand on 25 November 1958 in U.S.C.G.C. *Staten Island.* Members were:

H. J. Harrington, Leader and geologist
E. B. Fitzgerald, Deputy-leader and surveyor
B. Alexander, Surveyor
A. C. Beck, Geologist
J. Harrison, Mountaineer assistant
A. J. Heine, Stores officer
G. Henderson, Surveyor
W. Romanes, Mountaineer assistant
I. G. Speden, Geologist
M. R. White, Mountaineer assistant
J. G. Wilson, Mountaineer assistant
K. C. Wise, Mountaineer assistant and radio officer

The object of the expedition was to make landings at Wood Bay and Terra Nova Bay and, with the aid of a United States helicopter, to carry out geological and topographical reconnaissances of a number of valleys. Sea ice prevented these landings, however, and the expedition spent the summer in and around McMurdo Sound. There they carried out detailed geological work and fixed a number of positions lying in the area covered by United States trimetrigon air photographs. Geological and topographical work were carried out on Coulman Island, White Island, Black Island, Beaufort Island and at Cape Crozier and Minna Bluff. Visits were made to a number of other places in Victoria Land.

A party climbed Mount Erebus and examined ash shower sections around the crater; also Mount Terror and, a first ascent, Mount Discovery.

UNITED STATES GEOLOGICAL SURVEY FIELD WORK IN SOUTH VICTORIA LAND, 1958–59[1]

[By Warren Hamilton and P. T. Hayes, United States Geological Survey.]

During the southern summer of 1958–59, the U.S. Geological Survey began field work on a small scale west of McMurdo Sound, as part of the U.S. Antarctic Research Program. W. Hamilton and P. T. Hayes arrived at the U.S. Naval Air Facility, McMurdo Sound, from New Zealand on 16 November 1958. They were transported by ski-equipped Otter aircraft to a camp on the upper Taylor Glacier, near Beacon Heights, and by helicopter to camps at Lake Bonney, in Taylor Dry Valley, and in the previously unvisited dry valley north of the lower Taylor Glacier and east and north of Solitary Rocks. Twenty-six days were spent in the field.

The result of this work will be a report and a geological map of a 50-mile strip extending most of the way through the mountains from McMurdo Sound to the interior ice plateau. West of the meta-sedimentary rocks of the coastal metamorphic belt, here 15 miles wide, is a composite batholith, whose separate plutons of diverse granite types and metamorphic septa were mapped. Above these crystalline rocks, and mainly in the west, is the Beacon sandstone which was subdivided into several units for survey. Sills of diabase, as much as 1000 ft. thick, intrusive into the sandstone show marked differentiation. Numerous small cinder cones of basalt of Quaternary age, including some younger than the recent glacial maximum, overlay the granites of Taylor Dry Valley. A north-trending normal fault, with a displacement of 000 ft. on the west side, passes west of Solitary Rocks.

The area studied is within the mountain system that is believed to extend across Antarctica from the Ross Sea to the Weddell Sea. Numerous geological criteria suggest that this mountain system is the site of an early Palaeozoic, or very late Pre-Cambrian, orogeny with metamorphism instead of being an uplifted block of older Pre-Cambrian rocks. Pre-Cambrian basement rocks, characterized by hypersthenic varieties, form most of the outer coast of Dronning Maud Land, Australian Antarctic Territory, Terre Adélie and the Ross Dependency and presumably most of the interior, but the crystalline rocks and structures of the trans-continental mountains are of entirely different character.

[1] Publication authorized by Director, U.S. Geological Survey.

NOTES

SOVIET SCIENTIFIC INSTITUTIONS

The Arctic Research Institute [Arkticheskiy Nauchno-Issledovatel'skiy Institut] in Leningrad was renamed in 1958 the Arctic and Antarctic Research Institute [Arkticheskiy i Antarkticheskiy Nauchno-Issledovatel'skiy Institut.]

The Research Institute of the Geology of the Arctic [Nauchno-Issledovatel'-skiy Institut Geologii Arktiki] in Leningrad was founded not later than 1955 and is responsible to the Ministry of Geology and Conservation of Resources of the U.S.S.R. [Ministerstvo Geologii i Okhrany Nedr SSSR]. It appears to have taken over the geological commitments and records of the Arctic Research Institute. The Director is now B. V. Tkachenko. The Institute put into the field eleven expeditions in 1957, and over a thousand members of its staff in 1958. It publishes *Trudy* [*Transactions*], of which the latest issue was numbered **93**.

FORECASTING BREAK-UP AND FORMATION OF ICE AT RIVER MOUTHS

[From papers by V. S. Antonov and A. P. Burdykina in *Trudy Arkticheskogo Nauchno-Issledovatel'skogo Instituta* [*Transactions of the Arctic Research Institute*], Tom 209, 1958, p. 5–68 and 69–108.]

The break-up of ice on a river is directly linked to the climate of the river basin. V. S. Antonov's study relates to the lower reaches and mouths of rivers flowing into the Laptev Sea. All the rivers flowing northwards, the most important single factor controlling the date of break-up is the arrival of the spring flood wave. This in turn depends on the amount of snow lying in the basin, and on whether the thaw is quick or slow. Another factor is the strength of the river ice, which varies with the severity of the winter. But there are not enough measurements of any of these parameters to permit calculation on this basis, so the forecaster must fall back on correlations with atmospheric processes in general. During the winter the most notable of these is the Siberian anticyclone centred in Mongolia. This develops a spur towards north-eastern Siberia, the disintegration of which provides a useful index of the change from winter to spring circulation. This change, however, comes about only after a preparatory period which is not distinguishable from the synoptic charts of this part of Siberia alone. Here Antonov refers to a work by Vangengeym[1] which has become the corner-stone of long-range forecasts for the Soviet Arctic, but which has never been made available outside the U.S.S.R. In this work Vangengeym analysed typical synoptic situations in the northern hemisphere since 1891, and from these derived three main circulation patterns—easterly

[1] Vangengeym, G. Ya. Osnovy makrotsirkulyatsionnogo metoda dolgosrochnykh meteorologicheskikh prognozov dlya Arktiki [Principles of the macro-circulation method of long range meteorological forecasts for the Arctic]. *Trudy Arkticheskogo Nauchno-Issledovatel'skogo Instituta* [*Transactions of the Arctic Research Institute*], Tom 34 [*Special series*], 1952.

vesterly, and meridional. Antonov shows that the change from winter to pring is accompanied by an increase in the number of days with meridional irculation.

In seeking to use relationships of this sort for purposes of forecasting, ntonov insists that the area is much too big to expect that there will be a ignificant correlation, valid for the whole area, between ice break-up and any ne natural process. Each place must have its own correlation, and he sets out o try to find the closest ones. Many of these involve three variables. For nstance, he gives a formula to predict the break-up of fast ice at Ostrov 'reobrazheniya, off the mouth of the Khatanga, in terms of the number of ays with meridional circulation between February and April, and the period vhen air temperature at Khatanga exceeds 0° C., obtaining a correlation oefficient of $0{\cdot}91 \pm 0{\cdot}03$. This permits a forecast to be made 1–1½ months efore break-up. He provides similar correlations for points at or near the nouths of the Kheta, Khatanga, Anabar, Olenek, Lena and Yana, obtaining oefficients of between 0·66 and 0·91. The period of the forecast varies from everal months to only a week or two. He emphasizes that as the number of bservations increases—those he has used cover the period 1935–55—so it hould be possible to find more accurate correlations.

A. P. Burdykina deals with the formation of ice in the autumn in the same rea. She sets out to find a long-range correlation, and appears to succeed in etecting one with the gradient of pressure anomalies between northern and outhern Yakutiya in January, when, she claims, the course they will follow in ne summer and autumn is already apparent. In checking this method against ctual results from 1936 to 1955, she found that her predictions were 90 per ent effective for the Lena at Kyusyur, 93 per cent for the Olenek at Ust'-lenek, and 98 per cent for the Yana at Ust'-Yansk; a given prediction being onsidered 100 per cent effective if it deviated from the correct answer by nder one-fifth of the number of days between the earliest and latest known ates of freeze-up.

SOVIET AUTOMATIC RADIOBUOYS AND METEOROLOGICAL STATIONS

'rom *Morskoy Flot* [*Merchant Fleet*], 1958, No. 11, p. 17–20; Moscow Radio, 11 March 1959; nd *Nauka i osvoyeniye Arktiki* [*Science and the conquest of the Arctic*] by Ya. Ya. Gakkel', eningrad, 1957, p. 36–37.]

ne of the most interesting pieces of information provided by the Soviet drift-ig stations in the Arctic Ocean is the course followed by the floe on which they re placed. Such information can be obtained, however, in a simpler manner by ne use of unmanned radio equipment; a transmitter can send out a signal at egular intervals, and this can be received by two direction-finding stations on hore and the position plotted. The idea was first tested in 1947 when a "radio-uoy", designed by L. P. Samsoniy and Ya. Ya. Gakkel', was turned adrift in ne Kara Sea. Later, radio beacons developed by Yu. K. Alekseyev of the rctic Research Institute [Arkticheskiy Nauchno-Issledovatel'skiy Institut]

were used on a larger scale; 17 in 1953, lasting an average of 43 days each, 12 i 1954, at least 6 in 1956, and 14 in 1957.

By this time, however, the equipment was being improved by Alekseyev t transmit a weather message, rather than a signal carrying no message. The nev apparatus, known as a drifting automatic radio meteorological statio (DARMS), consists of a mast carrying the meteorological instruments an antenna, with the clock, transmitter and batteries in a hermetically seale container under the ice, in the water, to ensure the most constant temperatur possible. The meteorological elements measured are wind speed and directior and air temperature and pressure. The first two DARMS went into use in 1956 and there were eleven in 1957. The early models were found to be accurate t within ± 1 m. per sec., $\pm 1°$ C. and ± 1 mb. The range of the transmitter i 1500 km. The calculated endurance of the station is one year, but it seems tha not many in fact continue as long as that, since the main feature of the 195 programme was the establishment of stations in the autumn, after the end c the navigation season, in order to obtain winter readings. The DARMS ar normally flown to the starting point of their drift, but research is being dor on a type which will not require the aircraft to land. The simple beacons ar also still used. In the spring of 1959 it was expected to set up 30 beacons an DARMS.

Only one paper[1] has apparently so far been published on the basis of th results obtained from these stations (in this case beacons). It is clear tha although the accuracy with which the positions can be plotted by directior finding is not high, adequate data for useful drift studies are neverthele obtained.

FISHERIES IN THE SOVIET ARCTIC, 1954 AND 1955

[From a paper by S. V. Mikhaylov in *Problemy Severa* [*Problems of the North*], Vypusk 1958, p. 238–52.]

The Soviet Arctic contributes about 1 per cent of the total Soviet catch of fis and sea mammals. However, the importance of the Arctic fishery is great than this would lead one to believe, for two reasons: the quality of the fis caught is high, being mainly salmonate species which are rare in the rest of tl country, and the catching areas are close to northern settlements, which alwa have a food problem.

The annual catch in 1954 and 1955 was between 25,000 and 26,000 metr tons. It was made up by contributions from the various river basins ar estuaries as shown in the table. Sea mammals were caught only in the Yenise estuary, where 2136 Ringed Seal and about 350 White Whale were taken 1955.

Fishing methods are basically the same in all areas. Seining accounts f 70 to 80 per cent of the catch. Fishing is mainly done in the summer, b winter techniques of fishing beneath ice are practised to a limited extent. It

[1] By N. P. Shesterikov in *Problemy Arktiki* [*Problems of the Arctic*], Vypusk 2, 1957, p. 8- 91.

clear that the catches could be considerably increased without great difficulty by improving facilities and methods. Oil pollution is said to be affecting stocks in the Ob'. The potentialities of fishing in the open sea have been found to be negligible.

Fish catch in the Soviet Arctic

Area	Catch (metric tons)	Species caught (numbers are percentage of total catch in each area)
Kara Sea region (1955)		
In Yamalo-Nenetskiy Natsional'nyy Okrug:		
Tazovskaya Guba	1,190	*Coregonus*, *Acipenser baeri baeri*, *Stenodus leucichthus nelma*, 75
rivers Taz and Pur	3,400	
Gydanskiy Zaliv and river Gyda	400	
Obskaya Guba	3,080	
lower river Ob'	8,450	
In Taymyrskiy Natsional'nyy Okrug and Igarka:		
Yeniseyskiy Zaliv and lower river Yenisey:		
Ust'-Port fish factory area	2,160	*Coregonus*, 65; *Acipenser baeri stenorrhynchus*, 8
Dudinka fish factory area	350	
Igarka fish factory area	590	
Pyasinskiy Zaliv	80	
river Pyasina and tributaries	200	
lakes near Noril'sk	160	
Total for Kara Sea region	20,060	
Laptev Sea region (1955)		
North Lena area (Bykovo, Ust'-Olenek and Tit-Ary fish factories)	1,810	*Coregonus muksun*, 26; *C. sardinella sardinella*, 18; *C. autumnalis*, 12
Yana	approx. 500	*C. sardinella sardinella*, 85
Khatanga	1,340	*C. sardinella sardinella*, 80
Total for Laptev Sea region	3,650	
East Siberian Sea region (1954)		
Kolyma	1,260	*C. sardinella sardinella*, 40; *C. nasus*, 15
Indigirka	approx. 1,000	*C. sardinella sardinella*, 46; *C. autumnalis*, 13; *C. nasus*, 13
Total for East Siberian Sea region	2,260	

WILD REINDEER IN THE SOVIET ARCTIC

[From a paper by V. M. Sdobnikov in *Problemy Severa* [*Problems of the North*], Vypusk 2, 1958, p. 156–68.]

Wild reindeer are now to be found in Soviet territory mainly in the Taymyr region. The reason for their survival here is that the northern part of the peninsula is uninhabited, which in turn is due to its unsuitability for domestic reindeer farming. The remoteness, total lack of fuel and poor pastures which prevent farming are no obstacle to wild herds.

The animals spend the winter in the southern part of the peninsula, and go north in summer. Some reach the islands off shore, crossing there and back on the sea ice. Observations of the migrations have been made at the biological station at Bukhta Ozhidaniya on the north shore of Ozero Taymyr. The north-

wards movement past here takes place in April and May, and the animals return southwards in September and October.

They are believed to eat mainly flowering plants in the northern regions, there being few lichens. The deer feed mainly in the valleys, where there is the widest variety of plants. The rut takes place in early November and calving in mid-June. The moult started at the end of July in 1949, the year for which there are the fullest observations, but which had a very late spring. No considerable seasonal changes of colour are observed. In adults antlers start to grow in May, and are cast after the rut. Warble infection is common, but nose fly and hoof disease (necrobacillosis) are unknown. The size of the herds has never been established. The proportion of sex and age groups on the basis of 400 deer seen in the vicinity of the biological station is 48 per cent adult females, 18 per cent adult males, 14 per cent two year olds of both sexes, and 20 per cent calves. The comparatively small number of adult males is ascribed mainly to predators, and for this reason the annual increase in numbers is estimated to be only 5 per cent.

The wild herds are now apparently threatened by uncontrolled hunting from the expanding industrial and transport undertakings on the borders of the peninsula, and a plea is entered for a count from the air and for control of hunting at a level which the results of the count will dictate. This level could later be raised if the wolves were reduced, which could be done by hunting them from low-flying aircraft in the spring, a method used successfully elsewhere in the Soviet Arctic.

INSTITUTIONS OF THE U.S.S.R. ACTIVE IN ARCTIC RESEARCH AND DEVELOPMENT

A useful compilation,[1] by Valdas Stanka, was produced by the Arctic Institute of North America in November 1958.

It consists of a preface and a list of 388 institutions grouped under the following general headings: central institutions and organizations, the main purpose of which is Arctic investigation; central institutions having special branches for Arctic activities; institutions located in Arctic regions for research, industry or education; organizations, central and local, for the administration and cultural development of northern native peoples; collective and state farms and similar organizations; other scientific organizations contributing significantly to work in the Arctic. The information about each institution varies, but includes location, history, branches, publications and names of directors.

There is also a list of 107 Soviet polar stations, with geographical positions and dates of establishment. The term "Arctic" is used in a broad sense to include not only regions north of the tree line, the 10° C. isotherm and the Arctic Circle, but also the adjacent territories connected for purposes of research and development with the Arctic proper.

All the facts quoted have been reported in recent Soviet literature.

[1] *Institutions of the U.S.S.R. active in Arctic research and development*, Arctic Institute of North America. November 1958, 100 p.

JOURNALISTS' VISIT TO SOVIET ARCTIC, 1958

From *Vodnyy Transport*, 13 November and 13 December 1958, and *Pravda*, 26 and 0 November 1958.]

At the request of foreign journalists accredited to Moscow, the Chief Admini-tration of the Northern Sea Route [Glavsevmorput'] organized a visit to the Soviet Arctic between 12 November and 5 December 1958. The group of wenty included a number of Russian, East European and Chinese journalists, ogether with representatives of *Humanité* (France), *Unitá* (Italy) and *Ny Dag* Sweden). IL-14 aircraft were used, and V. M. Driatskiy, a former leader of lrifting station SP-6, accompanied the party.

Stops were made at Arkhangel'sk, Mys Kamennyy on the Ob', Igarka and Dudinka on the Yenisey, Ostrov Diksona, and Nagurskaya, the airfield on the westernmost island in Zemlya Frantsa-Iosifa. Here bad weather caused delay, out on 25 November the party landed at drifting station SP-7, where they spent our days. The station was at that time about 400 km. from the north coast of Greenland. The return flight was made with landings at Mys Chelyuskina and Ostrov Diksona. The journalists reported themselves well satisfied with the rip, despite the continuous darkness for much of the distance.

CANADIAN SEA ICE FORECASTING SERVICE

Summarized from information provided by the Naval Member, Canadian Joint Staff London).]

nitial work in establishing the new Canadian ice forecasting service was carried ut during 1958 by the Naval Weather Service of the Canadian Navy, on ehalf of the Department of Transport. It forms part of a mutual arrangement etween Canada and the United States to obtain information about ice-infested reas along the north-east coast of Canada and in the Canadian Arctic.

An Ice Central was set up at H.M.C.S. *Shearwater*, the naval air station near Dartmouth, Nova Scotia, and began operating on 5 March. Lieut. Commander V. Markham, R.C.N., was in charge, and the staff consisted of six naval and ivilian meteorologists. Surface and air ice observations were relayed to I.M.C.S. *Shearwater*, and formed the basis of ice bulletins and forecasts. These ere passed to Halifax Radio for transmission to shipping. During March and pril the forecasts were provided for the Gulf of St Lawrence area, and during Iay and June for the Strait of Belle Isle. The Department of Transport con-ucted air reconnaissance flights to provide information from each area.

Later in the summer three field forecasting units were established in the anadian Arctic to provide current local information to ships operating in djacent waters. In addition, the units relayed ice observations to H.M.C.S. *hearwater*. There, together with information provided by Ministry of Trans-ort Ice Information Officers, Hudson Bay Co. employees and others, it formed he basis of five- and thirty-day forecasts which were transmitted back to he field units for relay to shipping in adjacent waters. The field units were

established at Churchill and Cambridge Bay in July, and at Frobisher Ba in August. The units operated until late September.

The existing ice-forecasting service for the central and eastern Arctic, whic has been provided for some years by the U.S. Naval Hydrographic Office continued to operate during the summer of 1958 and to issue five- and thirty day forecasts. The service for areas off the east coast of Newfoundland an Labrador, Baffin Bay and Davis Strait was also provided by U.S. Nava Hydrographic units.

In preparation for the transfer of the service from the Canadian Navy to th Department of Transport the Ice Central was moved in January 1959 to th departmental headquarters at Halifax.

"ICE LANDINGS" FOR PULPWOOD STORAGE IN EASTERN CANADA

[Summarized from articles by C. H. Duff, L. B. Rose and C. R. Silversides in *Transactions* *the Engineering Institute of Canada*, Vol. 2, No. 3, 1958, p. 99–107.]

A landing, in the pulpwood industry of Canada, is an area in which pulpwoo is piled for temporary storage on the way to the paper mill. An ice landing one of these areas made on the ice of a lake or river. Pulpwood stored in thi manner is ready to be moved to the mill without further handling when the ic melts. It is probable that between 50 and 75 per cent of the 20,000,000 tons c pulpwood transported annually by water in eastern Canada is stored during th

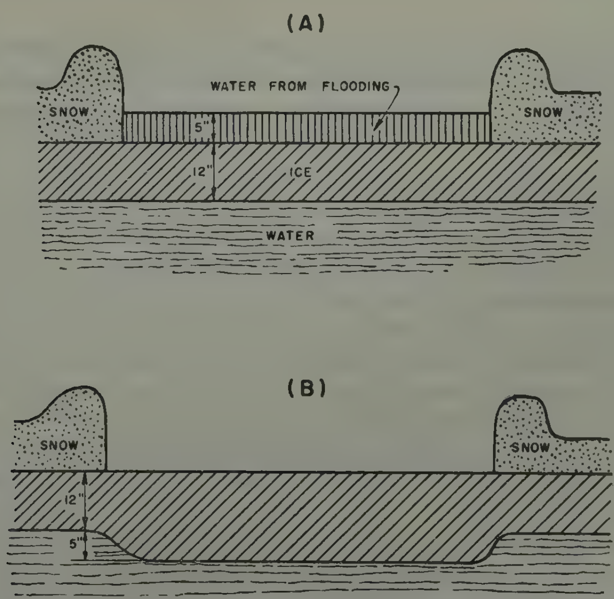


Fig. 1. Comparison of two methods of ice thickening: (*a*) freezing of water on surface take an estimated 15 hours, while in (*b*) equivalent thickness of ice requires 60 hours a −20 F. (−29° C.) to form.

winter on these ice landings. An ice landing may carry 10,000 to 100,000 cords of timber and varies in size between 20 and 200 acres (80,940 and 809,400 sq.m.); this represents a weight of 1125–2025 tons per acre. Construction and maintenance costs are about $150 an acre.

Construction. The object in the construction of ice landings is to increase the thickness and strength of the ice in the areas as quickly, and as early in the season, as possible. This is done by flooding, or slushing, the surface of the existing ice, and disposing of snow that falls on it during timber stacking operations. Fig. 1 shows two methods of thickening ice.

Construction begins when the ice in the area is strong enough to support men who, wearing snowshoes, tramp down the covering snow to pack it firm and reduce its insulating properties. As the ice becomes stronger rollers pulled by horses or light mechanized tractors, such as the J-5 Bombadier, are used. Slushing begins when the ice is about 4 to 5 in. thick. Holes are bored in the ice at intervals of 100 ft. (30·5 m.) and, around these, collars of packed snow, 6 to 8 in. (15 to 20 cm.) high, are built to prevent water escaping down the holes. Water is then pumped up through the holes to flood the ice surface. Various types of pumps are used but the commonest are centrifugal pumps, powered by an air cooled engine, and with a capacity of about 40,000 gallons an hour. The pumps are generally mounted on a sledge and moved about the ice by means of a small tractor. The depth of water pumped over the ice surface at each stage is about 2 in. (5 cm.). This depth of water will freeze overnight even if the temperature is slightly above −18° C. (0° F.), and a greater depth may result in a layer of supercooled water being held between the old and new ice surfaces. Special treatment is required to strengthen points at which roads of access from the shore join the ice. This may consist of extra slushing to build up a greater depth of ice, or of reinforcing the slush ice by freezing straw, brushwood or timber into it. A still stronger result is obtained by the use of a pole mat, interwoven with cables and anchored at one end to the shore, being frozen into the slush ice. Fig. 2 shows the comparative strength of various methods of reinforcing ice. Ice roads and bridges are built up to a greater thickness than the rest of the ice landing, and their surfaces kept clear by means of snow ploughs. Roads between timber piles are 150 to 200 ft. (45 to 60 m.) wide. This is to allow space for several lanes of traffic, and so distribute the wear caused by vehicles on the ice. The thickness of ice required varies with the weight of transport used. A horse and loaded sleigh is safe with 8 to 12 in. of good ice. Small trucks can work on 16 in., but 24 in. is a safe margin. Trucks weighing up to 10,000 lb. (4545 kg.) and carrying a load of 40,000 lb. (18,180 kg.) of pulpwood can move with safety on ice 24 in. thick.

Operations on ice landings. Two or more sites on the ice landings are used at a time for piling wood. The weight of wood often causes the ice to sink and to be flooded; when the water becomes too deep for transport to operate another site is chosen. The first piles of wood are built round the perimeter of the ice landing in order to distribute the weight on the ice, and to keep the centre free of water. This pattern of loading also reduces road maintenance as work progresses inwards and progressively lessens the length of the roads. The

wood piles act as snow fence, again reducing maintenance. Driving at high speeds frequently results in a vehicle breaking through the ice, and 10 m.p.h. is the usual maximum safety speed.

Maintenance. Maintenance consists mainly of either rolling or ploughing the snow cover of the ice landing, and of repairs to damaged areas. It is usually

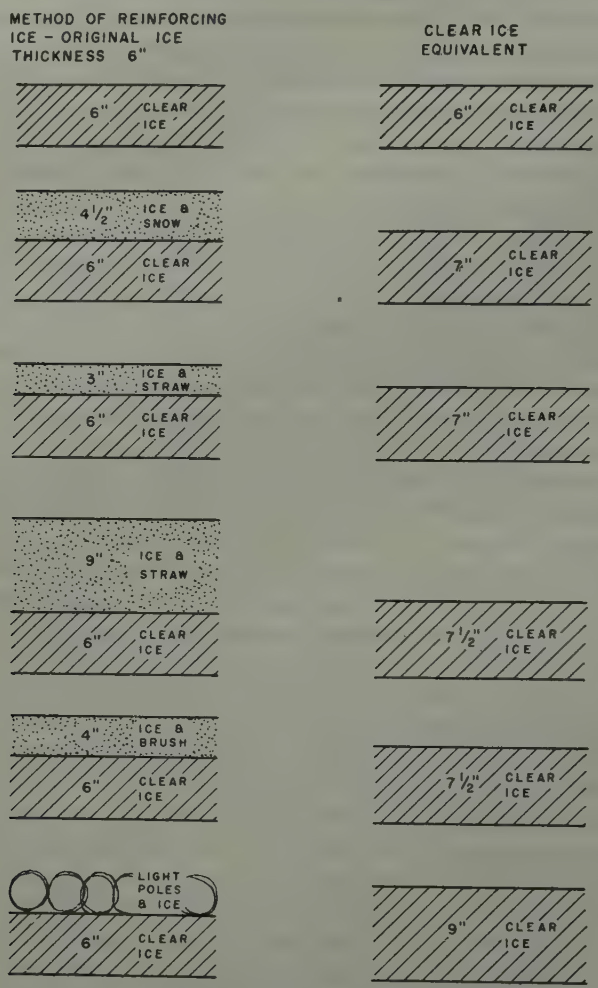


Fig. 2. Relative strength of various methods of reinforcing ice.

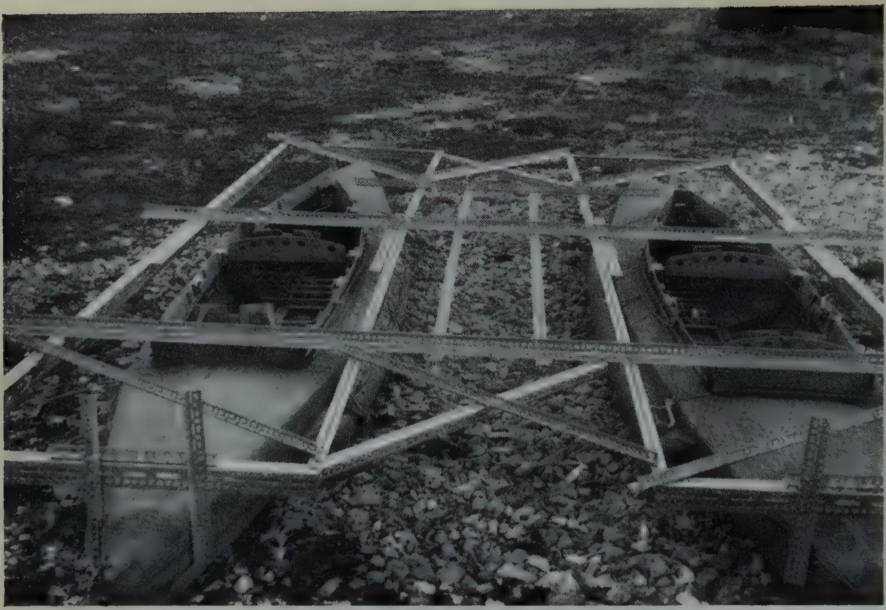
necessary to keep rollers at work all day during the loading period to prevent any considerable depth of loose snow from building up. If snow ploughs are used the snow is cleared to some distance ahead of where the vehicles are working to allow ice thickening. The main objections to the use of snow ploughs are that the weight and insulating properties of the snow which they accumulate weakens the ice landing, and that it takes up space required for wood

Ice landing with 100,000 cords of wood stacked on the ice. This landing, at Eades in northern Ontario, extends for about 1½ miles from the shore

Ice landing surface being flooded by a pump on a horse-drawn sleigh

Photographs by courtesy of Abitibi Power and Paper Co. Ltd.

(*Facing p.* 584



Aluminium frame converting two canoes into a catamaran

Photograph by M. M. R. Freeman

Ice landing with Snow mobile towing a wooden roller to compact the snow

Photograph by courtesy of Abitibi Power and Paper Co. Ltd.

storage. In practice, the snow is usually disposed of by being ploughed up over the wood piles.

Brushwood or poles placed in damaged areas accelerate the freezing process and strengthen the patch.

A LIGHT FOLDING CATAMARAN

[Summarized from notes by M. M. R. Freeman.]

The Reading University Zoological Expedition to Vestspitsbergen, 1957, designed a folding craft that proved both light and seaworthy, and capable of carrying a considerable bulk, and weight of cargo. It consisted of two collapsible canoes over which was lashed a light metal frame. The frame made of lengths of slatted-angle aluminium bolted together fulfilled the dual purpose of forming a support for loads and of converting the canoes into a stable catamaran.

Canoes. The expedition used two standard Commando collapsible canoes (Mark 1***), which were obtained through the Admiralty, similar in design to Eskimo kayaks but easier for novices to handle. They were 18 ft. long, with a beam of 3 ft. and a draught of 6 in. with two men aboard. Each weighed about 100 lb. complete with accessories, and packed into three canvas bags. Lighter weight canoes might be equally satisfactory provided that they have strong transverse ribs (if possible glued, screwed and jointed) and a strong ash coaming, to which the metal frame is fitted. The coaming should also be low and horizontal, rather than raked, to enable the frame to be lashed level across the canoes. Four hooks are screwed to the coaming to engage the frame lashings, iron coat-hooks are admirable for the purpose. The frame is lashed to the canoes by means of the hooks and of metal rings fitted on the stem and stern of each hull.

Frame. This was constructed from slatted angle aluminium; 135 ft. of "Dexion 255 A" was used for the main frame, and 65 ft. of "Dexion 140 A" for the bracing struts. The parts of the frame were bolted together with "Dexion" bolts. The total weight of the frame was 60 lb. The design is shown in the photograph, measurements will depend, of course, on the size of the canoes used.

Motors. A 34 c.c. sideboard motor, capable of about 4 m.p.h. at half-throttle, was used. It had a petrol consumption of 9 hr. running per gallon, and weighed 15 lb.

Conclusion. Experience of this craft suggests that it might prove a very useful general purpose one for scientific parties. The stability gives it the advantage of a flat bottom boat, enabling dredging and similar operations to be carried out in safety. The large platform area is invaluable for seine netting. It is easy and quick to assemble, and light enough to be carried on a man-hauled sledge.

THE ROSS DEPENDENCY RESEARCH COMMITTEE

[Summarized from information supplied by the Secretary.]

In February 1958 the New Zealand Government decided to continue the operation of the scientific stations at Scott Base and Hallett in the Ross Dependency, after the conclusion of the International Geophysical Year on 31 December 1958.

The responsibility for co-ordinating all New Zealand activities in the Ross Dependency was assigned to the Hon. P. N. Holloway, Minister in Charge of Scientific and Industrial Research. An advisory committee, the Ross Dependency Research Committee, was set up at the same time. This consists of representatives from the following official bodies: Meteorological Service, Dominion Museum, New Zealand University, Lands and Survey Department, Chiefs of Staff Committee, Department of External Affairs, Dominion Physical Laboratory, Geological Survey, Oceanographic Institute, Geophysics Division of D.S.I.R. and Head Office of D.S.I.R., and the Royal Society of New Zealand. The Chairman is R. G. Simmers, Meteorological Service; the Vice-Chairman is E. I. Robertson, Geophysics Division, D.S.I.R.; and the Secretary is G. W. Markham, D.S.I.R. In addition to its advisory duties the Committee is to present an annual report to the Minister; to co-ordinate and supervise New Zealand activities in the Ross Dependency, to co-ordinate New Zealand activities with those of other countries working in Antarctica, and to co-ordinate the publication and dissemination of scientific results.

The Department of Scientific and Industrial Research, in addition to co-ordinating executive action, also initiates such action on any matters not clearly the responsibility of other authorities. An Antarctic Division (G. W. Markham, Superintendent) of this department is in charge of putting the Antarctic programme into operation. Communications should be addressed to:

The Superintendent, Antarctic Division, Department of Scientific and Industrial Research, P.O. Box 6022, Wellington, New Zealand.

The Committee also serves as the New Zealand National Committee for Antarctic Research, and E. I. Robertson is New Zealand delegate to the Special Committee on Antarctic Research (S.C.A.R.) of the International Council of Scientific Unions (I.C.S.U.).

UNITED STATES ORGANIZATION FOR ANTARCTIC ACTIVITIES

[Summarized from information provided by G. R. Toney, U.S. Antarctic Research Program.]

During the International Geophysical Year, United States scientific activities in the Antarctic were conducted by the Antarctic Committee of the U.S. National Committee for the I.G.Y., set up by the National Academy of Sciences.

At the close of the I.G.Y. it was decided that scientific work in polar regions should be budgeted and co-ordinated through the National Science Founda-

tion. The U.S. Antarctic Research Program (U.S.A.R.P.) was therefore set up by the Foundation to co-ordinate recommendations and proposals from Federal and non-government agencies with reference to Antarctica. In addition to formulating the scientific programmes, it arranges logistic support with U.S. Naval Support Force, Antarctica, and acts as liaison between the various groups and institutions concerned with Antarctic research. Dr T. O. Jones is Director of U.S.A.R.P., and A. P. Crary, who spent 2½ years in Antarctica during the I.G.Y. in charge of U.S. field activities, is Chief Scientist.

The Committee on Polar Research, National Academy of Sciences, Chairman, Lawrence M. Gould, is the United States adhering body to S.C.A.R. At the request of the National Science Foundation, it also assists in developing scientific policies and long-range objectives for polar research. There are advisory panels on biological and medical sciences, earth's crust and core, cartography and geodesy, heat and water, and the upper atmosphere.

Advice on matters of government interest in the Antarctic scientific programme is presented through the Interdepartmental Committee on Antarctic Research, Chairman Alan T. Waterman.

Logistics support for U.S.A.R.P. is provided by the U.S. Naval Support Force, Antarctica, commanded by Rear-Admiral D. M. Tyree, who succeeded Rear-Admiral G. Dufek in September 1958. This support includes transportation of supplies and personnel to Antarctic stations, air support of traverse parties, radio communications and the provision of station support personnel.

The U.S. Antarctic Projects Office, Officer-in-Charge Rear-Admiral D. M. Tyree, reports to the Secretary of Defense on the political, scientific, legislative and operational aspects of U.S. Antarctic activities.

RADIOACTIVE AGE DETERMINATION OF ANTARCTIC ROCKS

[Summarized from S. S. Goldich, A. O. Nier and A. L. Washburn. A^{40}/K^{40} age of gneiss from McMurdo Sound. *Transactions, American Geophysical Union*, Vol. 19, No. 5, 1958, p. 956–58.]

A sample of paragneiss bedrock from Gneiss Point, Ross Dependency, has been dated at 520 million years by analysis of A^{40} to K^{40} in biotite separated from the gneiss. The sample was collected in 1957 by R. P. Goldthwait and A. L. Washburn, and the determination carried out at the University of Minnesota.

Gneiss Point is part of the Victoria Land Pre-Cambrian Shield composed of metamorphic and intrusive crystalline rocks overlain by sedimentary series of lower Palaeozoic and of Mesozoic age. It is separated from the folded Mesozoic and Cenozoic rocks east of the Ross Ice Shelf by a large fault zone which is thought to extend from McMurdo Sound to the Weddell Sea. Gneiss Point is situated on this zone and is also close to the volcanic islands of the Ross Sea. If it is assumed that the Gneiss Point rocks have not been affected by geological events subsequent to the formation of the paragneiss, then the metamorphic rocks mark a period of orogeny at the close of the Pre-Cambrian, or in Cambrian, times.

LOSS OF *HANS HEDTOFT*, 1959

[Summarized from *Folketingets forhandlinger*, 11 February 1959; *Udskrift af Retsbeg for Søforhør ved Sø- og Handelsretten i København*, 12 February 1959 and *Berlingske Tidende*, 31 January and 13 February 1959.]

Hans Hedtoft, Den Kgl grønlandske Handel's new ship for Greenland service, was built at Frederikshavn Vœrft og Flydedok and launched on 13 August 1958. She was an ice-strengthened vessel with welded plates, 25 mm. thick, rivetted on to the frame, and an ice knife and fins to protect the screw. Her dimensions were: length 87·8 m., beam 14 m., cargo capacity 1730 metric tons.

She sailed from København on her maiden voyage to Greenland on 7 January 1959 and began the homeward voyage from Julianehåb on the 30th, in fine weather, with a crew of 40 and 55 passengers. In the Kap Farvel area the weather deteriorated and a north-easterly wind increased to force 8 or 9. At about 17.00 hr. a distress signal was received by the weather station at Prins Christians Sund reporting that she had struck an iceberg and that water was coming into the engine room. She gave her position as lat. 59·5° N., long. 43° W. No details of the collision and its effects were given, but it became apparent that her engines had been put out of action, that she was without electricity, and being forced to rely on a small emergency transmitter.

The rescue organization at the Danish naval station at Grønnedal, south-west Greenland, went into action, while the 400-ton German trawler *Johannes Kruss*, skipper Albert Sierck, which was in the area and had just received permission from her owners to withdraw on account of the weather, immediately went to her assistance. United States and Canadian airforce rescue organizations also joined in the rescue. Bad weather, however, hampered these operations. *Johannes Kruss* was in continuous radio contact with *Hans Hedtoft*. At 20.30 hr. she had reached the position where the collision took place, but visibility was bad, and, although rockets were fired by *Hans Hedtoft*, and *Johannes Kruss* projected her searchlights up into the sky, neither vessel ever saw a sign of the other. At 20.41 hr. *Hans Hedtoft* reported that she was sinking slowly. Nothing further was heard from her, except a radio location signal which was broken off in the middle, at 21.06 hr.

Search operations continued during the following days. A large number of Canadian and United States aircraft, and sixteen ships of various nationalities, took part. No trace was found, however, and on 6 February the Danish government announced that *Hans Hedtoft* and all aboard must be considered lost.

S.C.A.R. BULLETIN

No. 3, September 1959

Third meeting of S.C.A.R. held in Canberra, 2 *to* 6 *March* 1959

Present: President: G. R. Laclavere

Delegates: Argentine, R. N. Panzarini; Australia, K. E. Bullen; Belgium, J. van Meighem; France, G. Weill; Japan, K. Wadati; New Zealand, E. I. Robertson; Norway, L. Harang; South Africa, A. L. Hales; United Kingdom, G. de Q. Robin; United States, L. M. Gould; U.S.S.R., M. M. Somov

Observers: S.C.O.R., G. F. Humphrey; W.M.O., K. Langlo

Advisers: Argentina, I. Picard; Australia, R. Carrick, W. J. Gibbs, G. F. Humphrey, F. Jacka, B. P. Lambert, P. G. Law, D. F. Martyn, G. M. Rayner; France, J. Delannoy; New Zealand, R. G. Simmers; South Africa, J. J. Taljaard; United Kingdom, F. Debenham, M. Hotine, J. Macdowall, R. E. Priestley; U.S.A., R. Brode, A. P. Crary, T. Gray, W. Lanterman, C. Reece, M. J. Rubin, W. J. L. Sladen, H. Wexler, N. A. Weber, G. D. Whitmore; U.S.S.R., B. L. Dzerdzeyevskiy.

(*a*) *National Antarctic Committees.* It was reported that, since the second meeting of S.C.A.R., the following countries had formed these committees: Argentina, Norway, United Kingdom, U.S.S.R.

(*b*) *S.C.A.R. Bulletin.* It was stated that the Soviet Antarctic Committee did not wish to publish the bulletin in Russian. It would, therefore, only be published in English.

(*c*) *International co-operation and exchange of personnel.* The following examples of exchange of personnel were reported: two South African meteorologists worked at Halley Bay during 1959; at "Scott Base" an Italian worked during 1958, and United States scientists during 1958–59; a New Zealand scientist joined a United States traverse in 1958; "Hallett" station has been run jointly by New Zealand and the United States, and the United States are now co-operating with Australia and Argentina in "Wilkes" station and "Ellsworth" station; two United States biologists worked at the Argentine station on Deception Island during 1958–59; an Argentine meteorologist served at the Weather Central at "Little America" during 1958; and there had been several exchanges of personnel between "Mirnyy" and "Little America" during the past two years.

(*d*) *Programme for* 1960. Some tentative plans for 1960 were reported:

Argentina. The scientific programme will follow the same lines as that for 1959, with an increase in the glaciological observations at "Ellsworth" station and the establishment of a seismograph at "Orcadas".

Australia. Work at all A.N.A.R.E. stations will continue along similar lines to 1959 but with greater concentration on field activities. Seismic sounding equipment, for ice-thickness determinations, is to be transferred from

Mawson to "Wilkes" station. It is planned to make traverses inland from "Wilkes".

Belgium. An extension of the 1959 work is envisaged, with expanded programmes of biology and geology. It is hoped to establish a station on inland ice.

France. The 1960 party in Antarctica is expected to consist of fourteen men, including seven scientists. The 1959 programme will continue, with the possible addition of biology. Oceanographic work is envisaged, particularly between Tasmania and Terre Adélie. The geophysical programme at Îles de Kerguelen will continue and a party of sixty-seven men are expected to spend 18 months there.

Japan. Scientific activities are expected to continue at "Syowa".

New Zealand. Geological survey will be carried out in the area south of Nimrod Glacier and west of Beardmore Glacier. It is aimed to put two four-man parties into the field, one supported by Sno-cats and the other by dog teams and aircraft.

Oceanographic work will continue in the Ross Sea, probably on specific problems arising from the work carried out in 1959. A seismic programme is also planned to determine sediment thickness overlying the basement rock of the Ross Sea, and, if possible, to gain some information concerning the crustal structure. Hydrological and bottom samples will be collected in the Balleny Islands-Macquarie Island region and magnetic surveys with proton magnetometers will continue in this area. Land-based biological work will continue as in 1959, in particular a study of the Adélie Penguin rookery at Cape Royds, where it is hoped to station a party during the summer.

South Africa. Decisions on the 1960 programme have not yet been received. South Africa has a continuing interest in the establishment of a station on Bouvetøya, and consideration is being given to another reconnaissance expedition to the island.

United Kingdom. It is probable that operations during 1960 will be on the same scale as in 1959 and that the majority of stations will remain operative.

U.S.A. Scientific programmes will continue at the "Amundsen-Scott" South Pole station and at "Byrd" station, and a medical and biological research programme will be carried out at McMurdo Sound. During the summer of 1959–60 traverses are planned from "Byrd" station and McMurdo Sound. U.S. scientists will continue to work at the joint stations of "Hallett", "Wilkes" and "Ellsworth".

U.S.S.R. Work at "Mirnyy" and "Vostok" will probably continue at the same scale as during 1959. A programme of aero-meteorology, glaciology and terrestial magnetism is planned for "Lazarev" station. Traverses are planned along the route "Vostok"—South Pole—Pole of Relative Inaccessibility—"Lazarev", but details are not yet definite.

(*e*) *Arrangements with World Meteorological Organization.* Dr Langlo announced that the W.M.O. has arranged to continue the I.G.Y. system of

allocating index numbers, and the use of special meteorological codes in Antarctica. The Commission for Synoptic Meteorology was investigating the communication problem of concentration and rediffusion of selected meteorological data for the whole of the Southern Hemisphere. The W.M.O. Conference in April 1960 would consider international arrangements for collecting and publishing selected data for the whole world, particularly upper air, ozone and radiation data.

(*f*) *I.C.S.U. rules for Special Committees.* It was noted that there were some differences between sections of the S.C.A.R. constitution and I.C.S.U. rules for Special Committees. This has now been referred to the I.C.S.U. Bureau, and the following answer has been received:

> "The Bureau of I.C.S.U., at its Meeting in Cambridge in April, agreed to recommend to the Executive of I.C.S.U., at its forthcoming meeting in The Hague, 30 September to 3 October, that the Constitution of S.C.A.R., as adopted at The Hague, March 1958, should be allowed to stand, in view of the exceptional structure of the Committee."

(*g*) *S.C.A.R. Publications.* Dr Robin was appointed Editor of S.C.A.R. publications.

(*h*) *Secretary and Vice-President.* The President announced with regret the resignation of Dr V. Schytt from the post of Secretary, owing to ill health. Dr Robin was elected in his place for a two-year term. Professor K. E. Bullen was re-elected as Vice-President for a further three years.

(*i*) *Message to Antarctic stations.* Delegates were requested to send the following message from S.C.A.R. to their respective Antarctic stations:

> "The 3rd Assembly of S.C.A.R. meeting in Canberra extends to all members of wintering parties heartiest wishes for every success in the field, and expresses confidence that their work will make international scientific co-operation a reality.
>
> Laclavere, President."

(*j*) *Polish membership.* An application by Poland to become a member of S.C.A.R. was considered, and the following resolution was approved: "This meeting accepts the adherance of Poland to S.C.A.R. as from the date of the disembarkment of their wintering party on the Antarctic continent." It was agreed that Poland should be kept fully informed of S.C.A.R. decisions and activities.

(*k*) *Argentine Antarctic Symposium.* It was suggested that the symposium, to be held in Argentina in November 1959, should include geology, glaciology and oceanography.

(*l*) *Working Groups.* The recommendations contained in the reports of the working groups (*m–r* below) were accepted.

(*m*) *Report of Working Group on Cartography.* Chairman, G. R. Laclavere

(1) The addresses of the Antarctic Mapping Centres were noted:

Argentina	Jefe de Servicio de Hidrografia Naval del Ministerio de Marina, Buenos Aires.

Australia	Division of National Mapping, Department of National Development, Canberra.
Belgium	c/o Comité Special Belge de la Recherche dans l'Antarctique, Ministère de l'Instruction Publique, Residence Palace Rue de la Loi 155, Bruxelles.
Chile	To be notified.
France	Institut Géographique National, 136 bis rue de Grenelle, Paris.
Japan	Geographical Survey Institute, 7–1000 Kamimegure, Megure-ku, Tokyo.
New Zealand	Surveyor-General, Lands and Survey Department, Wellington.
Norway	Norsk Polarinstitutt, Oslo.
Union of South Africa	Trigonometrical Surveys, Rhodes Avenue, Mowbray, Cape Town.
Union of Soviet Socialist Republics	Director, Arctic and Antarctic Institute, Leningrad.
United Kingdom	Directorate of Overseas Surveys, Kingston Road, Tolworth, Surbiton, Surrey.
United States of America	Chief Topographic Engineer, U.S. Geological Survey, Washington, 25, D.C.

(2) B. P. Lambert (Australia) was appointed permanent secretary of the working group.

(3) Members were urged to arrange automatic distribution to Antarctic Mapping Centres of all maps, and various types of information and data useful in the compilation of maps, of areas within the zone of interest of S.C.A.R.

The following recommendations were also made:

(4) All agencies planning activities in the polar plateau area should give serious consideration to the merits of continued geophysical and topographical surveys.

(5) On all flights in the polar plateau area airborne spot heights should be obtained by a combination of radio altimeter and barometric pressure readings, and be positioned by normal air navigation techniques.

(6) Antarctic Mapping Centres should forward to the Secretary their recommendations for all conventional signs, particularly those for ice features. The Secretary should prepare draft proposals for international conventional signs for consideration by the working group.

(7) That Australia, U.S.A. and U.S.S.R. should maintain and distribute up-to-date editions of their existing maps of Antarctica. This does not preclude other nations from publishing similar maps.

(8) That the metric system should be used in all Antarctic mapping.

(9) That a 500 m. contour interval, with supplementary contours at closer intervals when required, is suitable for maps at scales smaller than 1:1,000,000.

(10) That the International Spheroid should be used for all Antarctic mapping.

(11) That maps at a scale smaller than 1:1,000,000 should be on the polar stereographic projection, with standard parallel at 71°.

(12) That, in maps and charts at scale of 1:1,000,000, I.C.A.O. specifications for projections at that scale should be used, and also the common I.C.A.O., I.M.W. sheet lines along parallels and optional meridional limits.

(13) That, in maps and charts at scales larger than 1:1,000,000, sheet lines should normally subdivide 1:1,000,000 sheet lines and a conformal projection should be used.

(14) That the 1:1,000,000 scale should be adopted for hydrographic charting for scientific purposes, and general coastal navigation.

(15) That nations, while free to operate in such areas as they desire, should advise the Secretary of their proposed activities to preclude unnecessary duplication of effort.

(16) That the Secretary should distribute annually to all Antarctic Mapping Centres a list of new cartographical publications and publish a catalogue of these when necessary.

(17) That the Secretary should circulate to all Antarctic Mapping Centres details of the Soviet plan for the mapping of Antarctica, which suggests that different nations assume the responsibility for the mapping of certain sheets of a 1:3,000,000 scale map. That he should ascertain and distribute the views of member nations on this proposal, including proposed sheet lines and the areas they would be prepared to undertake. That the proposal should then be further considered at the next meeting of the working group.

(*n*) *Report of Working Group on Exchange of Information.* Chairman, G. de G. Robin. The working group recommended:

(1) The appointment of reporters for different scientific disciplines to assist the Secretary on Scientific matters. The following reporters and disciplines were suggested:

Physical and biological Oceanography. M. M. Somov, USSR, or substitute nominated by him.

Meteorology. W. J. Gibbs, Australia.

Geology. R. W. Willett, New Zealand.

Glaciology. A. P. Crary, U.S.A.

Terrestrial Biology and Medical Research. R. Carrick, Australia.

Upper Atmosphere Physics. O. Schneider, Argentina.

Seismology and Gravity. K. Wadati, Japan, or substitute nominated by him.

Cartography. Chairman of Working Group, G. R. Laclavere.

Communications. Chairman of Working Group, A. H. Sheffield.

Other recommendations were:

(2) That annual reports, consisting of brief factual statements of work carried out, should be distributed by Antarctic Committees. The secretary, with the help of the reporters, should list the nature of the material to be included in the report. Reports should include a bibliography of scientific works published during the year. The first report should cover the years 1957 and 1958 and should be distributed by November 1959; subsequent reports should be distributed by the end of June each year, beginning in 1960.

(3) That, to ensure full co-operation of effort in the fields of meteorology and oceanography, W.M.O. and S.C.O.R. should be invited to submit brief reports at the end of June each year, on activities of interest to S.C.A.R.

(4) That reports of activities proposed for the following year should be circulated not later than the end of June. The Secretary should indicate the nature of material to be included in these reports.

(5) That annual meetings of S.C.A.R. should take place in late August or September of each year in order that these reports may be previously available for delegates. This cancels the arrangement, made at the 2nd meeting of S.C.A.R., that meetings should be held during the northern hemisphere spring.

(6) That S.C.A.R. members should continue to make use of the services of I.G.Y. Data Centres as long as they continue to operate.

(*o*) *Report of Working Group on Biology.* Chairman, R. Carrick.

(1) It was recognized that marine biology is an integral part of oceanography and that the section in the Scientific Programme on "Oceanography" should include marine biology, and consist of two parts, physical and biological. Recommendations for the wording of this section were approved (see Annex, p. 596).

(2) It was recommended that an international symposium on biological and medical research in Antarctica should be held shortly.

(3) The need for conservation of Antarctic flora and fauna was noted, and the study of means of protection recommended.

(4) The formation of an international register of specialists, competent in the taxonomy of Antarctic flora and fauna, was recommended.

(5) The formation of a Biological Data Centre was not recommended.

(*p*) *Report of Working Group on Meteorology and Physical Oceanography.* Chairman, H. Wexler.

(1) Other member nations were urged to publish Antarctic climatological studies on the lines of those published by the United Kingdom and South Africa.

(2) W.M.O. was requested to co-ordinate arrangements for the continuation of the broadcasting of monthly "CLIMAT" and "CLIMAT TEMP" messages for Antarctic stations.

(3) The establishment of the International Antarctic Analysis Centre at Melbourne was welcomed; also the intention of U.S.A. to assign an analyst to the centre. It was noted that analyses would be distributed: (*a*) by radio, including radio teletype and facsimile, for current use, and (*b*) by reproduction for other uses. Requirements of various countries, and availability of technical facilities, require further investigation. Member countries were asked to make known their requirements.

(4) The intention of South Africa to continue a Southern Hemisphere Historical Map Analysis Series, after the completion of the I.G.Y. World Weather Map Series, was welcomed.

(5) Member nations were urged to develop and establish automatic weather stations and other methods of observation, such as reconnaissance aircraft and dropsondes, in Antarctica.

(6) The development of various types of equipment for measuring the horizontal transport of blowing snow was noted. Member nations were urged to pool knowledge of equipment and methods.

(7) The need for the establishment of weather stations on Bouvetøya and Peter I Øy was again emphasized.

(8) No action on the establishment of an Antarctic Meteorological Data Centre was recommended pending decisions reached at the forthcoming Third W.M.O. Conference.

(9) It was noted with satisfaction that most nations had already made arrangements for I.G.Y. meteorological observations to be placed on punch cards, as well as being published.

(10) A number of suggestions were put forward concerning improved Antarctic weather communications for the support of the International Antarctic Analysis Centre.

(11) A number of revisions were approved to the Meteorology section of the S.C.A.R. scientific programme (see Annex, p. 596).

(*q*) *Report of Working Group on Upper Atmosphere Physics.* Chairman, F. Jacka.

(1) The desirability for early publication of I.G.Y. data was stressed, in particular geomagnetic data, to assist in the planning of future work.

(2) The importance of stations within the southern auroral zone was stressed, and also the need for visual observations to supplement all-sky cameras. Visual observations should be made on the hours and quarter hours.

(*r*) *Report of Working Group on S.C.A.R. Programme amendments.* Chairman, L. M. Gould.

(1) It was recommended that proposed amendments for circulation to members should reach the Secretary at least three months before the meeting at which they are to be considered. Proposals reaching the Secretary after that time can be considered at the next meeting, but will not be incorporated in the S.C.A.R. Programme until ratified by a majority of National Antarctic Committees.

(2) A number of recommended alterations to the programme were approved (see Annex, p. 596).

(*s*) *Date and place of next meeting.* Both Paris and Cambridge were suggested. It was agreed that the meeting should be held in late August or early September 1960. Final decisions as to time and place were left to the Executive Committee.

(*t*) The President thanked the Australian Academy of Sciences and the Australian Government for the invitation to hold the meeting in Canberra, the admirable arrangements made for the meeting and the hospitality extended to delegates and observers.

Annex

Scientific investigations recommended by S.C.A.R.

A number of important alterations and additions have been made to the programme of scientific investigations recommended at the first and second meetings of S.C.A.R. The following list incorporates these, and supercedes the list published in *S.C.A.R. Bulletin*, No. 1.

Meteorology

A. General

(*a*) The heat and moisture budgets of the Antarctic atmosphere and ice sheet
(*b*) The mean air circulation in the Antarctic regions
(*c*) Local effects in the Antarctic, particularly in the vicinity of the coastline
(*d*) The nature and extent of broad-scale meteorological processes over Antarctica and the remainder of the Southern Hemisphere
(*e*) The mutual influence between pack ice and the character and motion of the air
(*f*) The air flow in the friction layer over the Antarctic continent
(*g*) The Antarctic stratosphere and the exchange of air between the stratosphere and troposphere as shown by such atmospheric tracers as ozone

A ten-year period of observations is desirable.

B. Synoptic observations. The greatly increased networks of meteorological stations established in Antarctica during the I.G.Y. has enabled a reasonably detailed knowledge of weather processes over the Antarctic to be obtained for the first time, and every effort should be made to maintain the present scope of surface and upper air observations, and to increase the network where possible.

The areas deficient in observations are:

(*a*) the area bounded by lats. 45° S. and 60° S. and longs. 45° W. and 35° E.
(*b*) the area bounded by lats. 45° S. and 65° S. and longs. 80° W. and 150° E.
(*c*) the area bounded by lats. 45° S. and 65° S. and longs. 80° W. and 170° W.
(*d*) the Antarctic coastal area between longs. 80° W. and 150° W. and in the vicinity of longs. 155° E., 125° E.
(*e*) and the areas centred over the following positions:

lat. 80° S., long. 0°	lat. 75° S., long. 130° E.
lat. 75° S., long. 30° E.	lat. 80° S., long. 80° W.
lat. 75° S., long. 60° E.	

As W.M.O. considers that the greatest need for an increased network is in the ocean areas within the field of interest of S.C.A.R., every effort should be made to secure surface and upper air observations from islands, ships and floating automatic stations in these areas.

The method of obtaining temperature for use in pressure reduction in the Antarctic should be standardized through the normal W.M.O. machinery. In particular, the restrictions imposed by W.M.O. on the reduction of pressure should be observed, the preferred reduction levels being 850 or 700 mb. as appropriate.

C. *Special observations*

(*a*) Continuous measurements of the ozone content of air at the surface of the earth
(*b*) Observations of the primary and secondary directions, amplitude and wave length, and form of sastrugi at Antarctic stations. These are to improve methods of observation, and to develop the relationships between sastrugi and the station winds for the purpose of interpreting data obtained by traverse parties and through air photography, in studying the climatology of Antarctica
(*c*) Aerial determinations of the albedo
(*d*) Micrometeorological and meso-meteorological measurements
(*e*) Atmospheric chemical and precipitation content determinations
(*f*) Morphological determinations of falling snow crystals and of condensation nuclei
(*g*) Observations of noctilucent and mother-of-pearl clouds
(*h*) Aircraft flying over, near, and to and from Antarctica should continue the recommended meteorological observations, also, where possible, should utilize dropsondes and other techniques for vertical probing of the atmosphere, and should report all information promptly
(*i*) Traverse parties should measure the temperatures of the ice down to 15 m., as the temperature at this depth is very similar to the mean annual temperature at the surface
(*j*) S.C.A.R. welcomes the efforts in progress to obtain total ozone content, surface ozone measurements, and vertical distribution of ozone by means of ozone-sondes, and urges the International Ozone Commission and the W.M.O. to devise schemes whereby the intercomparison in the Antarctic of the standards used for such measurements can be effected
(*k*) Measurement of aerosols
(*l*) Observations of radiation, solar radiation from sun and sky, radiation balance, and the use of balloon-borne net radiometers
(*m*) Experimental measurements of the amount of blowing snow for the purpose of ultimately standardizing these techniques through W.M.O. action

D. Atmospheric nuclear radiation. Stations engaged in measuring the radio-activity of air and precipitation should carry that work on as far as possible after the I.G.Y. Other stations are invited to initiate such a programme.

E. Rockets. Rocket-sounding programme should be enlarged to cover the winter season, measuring temperatures and winds up to 80 km., at the rate of one per week. Rocket-borne experiments to greater altitude for studies of

high atmospheric conditions and parameters of particular interest for the south polar cap.

F. *Acoustic probing of the upper atmosphere by means of surface explosions.*

G. An *International Antarctic Analysis Centre* has been established by Australia in Melbourne in order to develop and undertake current analyses and to study the appropriate techniques of analysis.

It is hoped that countries other than Australia will support this by sending analysts to participate in the programme.

Ionosphere

(*a*) Vertical incidence sounding. The programme should follow the principles suggested in the 1958 Edinburgh report of the U.R.S.I.–A.G.I. Committee. At least two stations on the Antarctic continent should be Class F (full) and the remainder should be Class P (patrol) stations and as many as possible should be continued for at least another half solar cycle.

(*b*) Special observations. (1) Measurements of atmospheric radio noise should be continued for a full solar cycle at a minimum of two stations. (2) Special studies should be made on whistlers and very low frequency emissions, absorption and scatter and low-level echoes which may be peculiar to the southern auroral zone or polar cap. These studies should be co-ordinated with special studies in other disciplines concerning the high atmosphere.

Auroral physics

(*a*) The morphology of visible auroras, H and He emissions and H.F. radio scattering regions

(*b*) The sources of energy producing geomagnetic and ionospheric disturbances and auroras

(*c*) The nature of the agency causing excitation of auroral emission

(*d*) The composition and physical state of the upper atmosphere

Observational programmes should continue at stations well distributed in Antarctic regions using the several techniques available, such as visual observing, all-sky photography, photometric, spectrographic, radar and parallactic photography.

Attention is drawn to the possibility of gaining new information on the geomagnetic field in regions far from the earth by comparing Arctic and Antarctic observations on V.L.F. radio emissions, auroras and cosmic ray variations. Such comparisons may also contribute to understanding the mechanism of production of auroras. This possibility should be considered before fixing the positions of any new Antarctic stations.

Geomagnetism

(*a*) A geomagnetic observatory programme with base line control should be maintained at several stations as part of the global network. Geomagnetic variation recordings should be encouraged at all stations

involved in upper atmosphere studies and the recording and analysis should be designed to meet these requirements. The importance of low sensitivity recording is emphasized.

(*b*) A geomagnetic survey of the permanent field in the Antarctic area (continent and southern seas) should be carried out and co-ordinated with the projected World Magnetic Survey.

Cosmic Rays

(*a*) Sources and mechanism of generation of cosmic rays
(*b*) Cause of changes of cosmic ray intensity which appear to be associated with changes in the distribution of matter and/or magnetic fields in interplanetary space
(*c*) Form of the geomagnetic field at great distances from the earth

These should be the subject of long-term observations from well-distributed stations.

Geology

In addition to classical studies special attention should be directed to:
(*a*) The terrain beneath the ice as revealed by seismic studies
(*b*) Post-glacial and/or Quaternary geology at coastal stations
(*c*) Palaeoclimatic studies
(*d*) Palaeomagnetic studies
(*e*) Submarine geology
(*f*) Geochemical studies of rocks and minerals, including submarine deposits

Glaciology

(*a*) Thickness, structure and volume of inland ice as revealed in seismic soundings. The bedrock beneath the ice should also be investigated by seismic shooting
(*b*) Long-term observations:
  (1) Changes of elevation by repeated seismic soundings, gravity observations, and standard survey observations
  (2) Repeated astronomical fixes for absolute movement
  (3) Study of the ratio between the loss of ice by spreading and the gains by accumulation
(*c*) Annual stratification of firn to establish climatological significant precipitation records
(*d*) Structure of the inland ice sheet and ice shelves as revealed from deep pits and deep bore holes, particularly near the top of ice caps
(*e*) Variations of velocity of propagation with depth in typical ice areas should be made by long reversed refraction shooting and also shooting in deep bore holes. This might also aid in the study of propagation laws as a function of depth, temperature, stress, etc.
(*f*) The application of indirect techniques to determine the nature of the bedrock under the ice by the use of electrical methods, etc.

(g) Measurements of the chemical constituents of glacier ice, including constituents of gases occluded in the ice

Geomorphology

Studies of land forms with particular attention to the geological role of an inland ice sheet, past and present.

Cartography

A comprehensive, co-ordinated mapping programme should have high priority.

Details of the initial programme have been approved by S.C.A.R. and will, in future, be co-ordinated by a permanent Working Group on Cartography.

Seismology

There are two principal problems of Antarctic seismological research:

(a) to use local earthquakes and explosions to infer Antarctic crustal structure, and

(b) to use distant earthquakes both to obtain evidence on Antarctic structure and also on the earth's deeper structure. The establishment of first-class seismological observatories in the Antarctic can fill in an important global gap.

The setting up of new seismological observatories in the Antarctic is largely experimental. Relevant factors include the suitability of particular sites (difficulties with microseims, etc.), the human difficulties, and the as yet not fully known local seismicity. The present number of seismological observatories in the world is about 700. There should ultimately be not less than a corresponding number, determined on the basis of geographical area, in the Antarctic. Stations should normally be uniformly distributed, but special problems and features of local seismic activity may make this undesirable in some areas. Each station, in addition to having an adequate set of good seismographs, should have assured absolute time marks recorded on the seismogram so that absolute time can be read to less than a second. Suitably located stations should in due course become permanent.

Gravity

(a) The determination of gravity for the purpose of utilizing the data for geodesy as well as for the study of the upper layers of the earth's crust, and for solving some problems of glaciology

(b) Extension of the world networks of basic gravity points to the Antarctic

(c) Measurements of gravity by ship-borne gravity meters be made by ships operating in the area of interest of S.C.A.R.

(d) Measurement with pendulum instruments as well as gravimeters with small or constant drift

Vulcanology

To begin with, vulcanological studies are likely to emerge from broader geological studies, and then become more specialized as development continues. The Antarctic borders on the Pacific Ocean, from round the rim of which comes 85 per cent of the total energy released in earthquakes. It is therefore important that great attention be paid to the seismic and vulcanological problems of the area.

Oceanography

Investigation in the seas adjacent to Antarctic coasts should be developed. Physical and biological studies should be made together, because interpretation of the latter depends on the former and both require the same expensive facility—a research vessel. Circumpolar study is necessary with work extending as far from the Antarctic coast as necessary to define the relations between Antarctic and adjacent areas.

A. Physical

(*a*) Study of bottom relief and sediments in the shallow shelf zone of the seas around the Antarctic continental shelf, as well as in the oceanic regions adjacent to the slope. Deep cores should be taken off the Antarctic continent

(*b*) Study of the Antarctic coastal current

(*c*) Study of ice in the Southern Ocean (its nature, distribution and movement) by systematic sea and air observations. S.C.A.R. recommends that all expeditions participating in the Antarctic and using aircraft should make systematic sea ice observations from aircraft throughout the year, and should organize the exchange of data with other expeditions using W.M.O. codes. Experiments with radio direction tracking of icebergs might be undertaken to study currents

(*d*) Study of the Antarctic Convergence zone in the Southern Ocean. Here multiple sections across the Antarctic Convergence are specially recommended (oceanographic observations and measurements of the surface currents should be made not far from the frontal line). It is desirable to carry out synchronous observations in the zone of the Antarctic Convergence, employing for this the greatest possible number of oceanographic vessels and expedition ships working in the Antarctic

(*e*) Study of the deep currents in the Southern Ocean especially in the field of the western wind drift, using the method of absolute water age determination

(*f*) Study of tides and tidal current changes in the coastal regions of the Antarctic. It is highly desirable to make a cycle of at least one full year and if possible continuous observations of sea level fluctuations at shore stations in the Antarctic

(*g*) Systematic seasonal deep observations along the following sections should be considered the minimum requirement:
   (1) South from Cape Town along long. 20° E.
   (2) South from New Zealand along long. 165° E.
   (3) Across Drake Passage

(*h*) Geochemistry. Measurements of major and minor chemical constituents in oceanic waters

B. Biological

(*a*) Regular collections in all seasons for qualitative and quantitative phyto- and zoo-plankton, with special reference to:
   (1) euphausiids, copepods, larvae and eggs
   (2) physical and chemical conditions associated with plankton occurrence
   (3) checks of zoo-plankton occurrence against stomach contents

(*b*) Primary production (pigments, ^{14}C fixation, oxygen method)

(*c*) Biochemistry of depigmented fish (Nototeniformes)

(*d*) Microbiological study of sea water, ice over sea water (in comparison with ice over land) and sea bottom

(*e*) Collections of coastal and pelagic fish and invertebrates

(*f*) Ecology and life histories of coastal flora and fauna (especially those under ice shelf) and of all benthic forms

(*g*) Results of work on whales should be exchanged with the Scientific Sub-committee of the International Whaling Commission

Terrestrial Biology and Medical Research

A. General

(*a*) The Antarctic offers unique opportunities for biological research, much of which closely relates to human occupation of this region. At present, there is much less research there in biology than in the physical sciences

(*b*) Mans' physical and biological impact on the endemic Antarctic animals, plants and microbes is still slight, but this undisturbed situation will soon pass as the isolation of this region from the rest of the world is reduced

(*c*) The severe environment has led to high physiological adaptation and relative ecological simplicity, the understanding of which sheds light on conditions elsewhere

(*d*) Biogeographical problems in the southern hermisphere require circum-polar study of the distribution of flora and fauna. This should extend as far from the Antarctic continent as is necessary to establish the biological relations between Antarctica and other land masses

B. Botany

(*a*) Surveys. Systematic and ecological studies should be supplemented by mapping and the establishment of permanent reference areas

(*b*) Phytogeography. Further work is needed in the following fields:
(1) Experimental cyto-taxonomy
(2) Physiological and ecological studies of related species-groups
(3) Micro-fossil investigations (peat pollens, diatoms, etc., including dating of peats and other organic materials)

(*c*) Conservation. Protection of representative areas of natural environments is an urgent need. The impact of man and introduced animals on the Antarctic environment should be assessed

C. Zoology

(*a*) Modern reference collections should be made throughout the region. Important groups are mammals, birds (breeding adults and immatures of known age), and external parasites

(*b*) Details of seasonal cycles (movements, breeding, moulting, etc.) should be based wherever possible on marked individuals (banded birds, branded seals) of known age and sex

(*c*) Collections of food samples and observations of feeding habits throughout the year

(*d*) Studies on population ecology of species which can be accurately counted (e.g. seals, birds). These should preferably be based on marked individuals

(*e*) Studies of land invertebrates and their ecological associations

D. Physiology

(*a*) Investigations of the effects of cold and of photoperiodism on man in the polar regions

(*b*) Antarctica offers highly specialized fauna with many possibilities for comparative studies of adaptation to extreme temperatures and light variation.

E. Behaviour

(*a*) Antarctic animals, especially sea birds and seals, are excellent subjects for analysis of social behaviour

(*b*) Study of the psychology of isolated groups of men

F. Microbiology

(*a*) Studies of snow, ice, frozen soil and air

(*b*) Investigation of the possible incidence of living microbes in rocks, fossils, meteorites, etc.

(*c*) In medical and animal microbiology, unique opportunities exist in Antarctica for studying man's impact upon a relatively uncontaminated environment. Study of public health problems such as the survival of bacteria under polar conditions, sewage disposal, and upper respiratory tract virus infections which occur when wintering-over groups are exposed to infective agents brought in on relief ships. A survey is required of diseases already present in Antarctica's isolated or semi-isolated fauna, and of their potential threat to man

Scientific stations in Antarctica, 1959 (omitted from *S.C.A.R. Bulletin* No. 2)

New Zealand

Scott Base

Location: lat. 77° 51′ S., long. 166° 48′ E., 15 m. above sea level.
Site: on rock. Method of supply, by sea and tractor.
Climate: Temperature, mean annual −20·8° C., max. 5° C., min. −52·5° C.
Wind, mean annual, 4·9 m./s., max. 39 m./s.
Cloudiness, mean annual 4⅝ oktas.
Facilities available: Buildings 10, accommodating 22.
Electrical power available: 28 kW.
Aircraft: 1 Beaver, 1 Auster during summer only.
Tractors, etc.: 4 Ferguson, 1 Weasel, 2 Sno-cats.
Personnel: Leader, L. R. Hewitt.
Chief scientist: B. P. Sandford.
Total: including U.S. scientists during winter of 1959, 4 scientists, 5 technicians, 4 others.
Scientific programme: Auroral physics, biology, cartography, geology, geomagnetism, gravity, ionosphere, meteorology surface and upper atmosphere, oceanography, seismology.

United Kingdom

Detaille Island (Base W) did not operate during the year.

Symposium on Antarctic Meteorology, Melbourne, 1959

The Symposium on Antarctic Meteorology was organized by the Australian Commonwealth Bureau of Meteorology, and supported by the Australian Academy of Science, the Special Committee for the I.G.Y. (C.S.A.G.I.) and S.C.A.R. It was held in Melbourne from 10 to 25 February 1959, with W. J. Gibbs as Chairman.

The symposium was divided into seven sessions, each with its own chairman and each dealing with particular subjects. Summaries of all papers, in English, French and Russian, were available before the symposium began.

1*st Session. Local effects.* Chairman, K. Langlo.

Dr Langlo drew attention to the many difficulties involved in defining local effects and determining their origin; questions of exposure, katabatic winds and methods of reduction of pressure were all closely related to local effects in the Antarctic.

Papers by F. K. Ball, G. M. Tauber and B. Valtat dealt with the katabatic wind, one of the most spectacular and persistent of Antarctic phenomena. Ball's contribution gave an interesting theoretical treatment of the problem. P. J. R. Shaw described the results of local observations near Mawson and the paper by Y. Morita and N. Murakoshi treated a similar aspect of observations from ships and shore stations. B. L. Dzerdzeyvskiy outlined some weather peculiarities of the Antarctic coastline.

In summing up discussions in this session, Dr Langlo said that, with the present density of observing network in the Antarctic, it was difficult to distinguish between local effects and the effects of large-scale circulation. He

stressed the importance of studies of local variation of elements in the vicinity of reporting stations, which should indicate to what degree observations are representative of the effects of large-scale circulations.

2nd Session. Synoptic analysis and forecasting. Chairman, Professor J. Van Mieghem.

The chairman pointed out that the symposium stressed the two basic aims of the I.G.Y. meteorological programme in the Antarctic: (*a*) the investigation of the general circulation in the Antarctic region, and (*b*) the investigation of the influence of the Antarctic on the general circulation of the Southern Hemisphere and the planetary circulation as a whole.

Operational meteorological problems and means of securing observations from automatic weather stations and similar devices were described by Commander W. S. Lanterman, U.S.N. T. I. Gray reported on the operation of the U.S. Weather Central in "Little America". W. J. Gibbs reviewed existing methods and models used in synoptic analysis of the Antarctic and the surrounding oceans, and J. J. Taljaard and H. Van Loon discussed the method of preparation of 500 mb. analyses. Synoptic case studies were described in papers by B. Lieske and J. Alvarez and by K. Hansen.

Professor Van Mieghem, in concluding the session, stressed the need for attention to the telecommunications system for transmission of Antarctic and sub-Antarctic data, and also referred to the need for the publication, on a uniform world wide basis, of controlled data for meteorological research on a planetary scale. He urged the provision of automatic weather stations and transosondes to fill the gaps in the reporting network over the oceans. He said that differences in meteorological practices had arisen regarding the identification of fronts and blocking, and suggested that the jet stream may form a useful foundation on which analyses could be constructed. Referring to the case studies which had been discussed in the session, he said that many more case studies were needed to improve our knowledge of the thermal and dynamic processes in the atmosphere.

3rd Session. Synoptic influences on lower latitudes. Chairman, J. F. Gabites.

E. B. Kraus posed a number of problems including questions of synoptic interaction, the effect of sudden warming of the Antarctic stratosphere, likely effects of hypothetical changes in solar radiation over the Antarctic, and the contribution made by Antarctica to the annual oscillation of air between the hemispheres.

A paper by F. A. Berson and U. Radok discussed the relationship between Antarctic surges and variations in the zonal circulation, including the effect of blocking and evidence of Simpson's pressure surges. Contributions by A. K. Hannay, and by R. Falconer and H. M. Treloar, discussed the synoptic features in the southern oceans and over Antarctica which are associated with cold outbreaks over Australia.

Dr Gabites, recapitulating the discussion, said that in order to determine influences of the Antarctic on synoptic processes in lower latitudes, it was

necessary to increase the available network of observations. He pointed out that the Antarctic continent now had a reasonable network of reporting stations, but that studies such as those described in the session were hampered by the very considerable distance between those in oceanic areas, and indicated that little progress could be expected with this problem until some method had been found of filling this gap. He also suggested that it was necessary to look at the hemisphere as a whole in studying the interaction between processes over the Antarctic and lower latitudes, and, in particular, to have due regard for the significance of the long wave pattern in the development of significant synoptic features.

4th Session. Circulation studies. Chairman, W. J. Gibbs.

A paper by R. H. Clarke gave the results of a model experiment containing a cold dome to simulate the Antarctic continent. A paper by A. M. Gousev discussed wave disturbances on the permanent low level inversion over the Antarctic continent. Studies by J. Langford, H. Van Loon and P. D. Astapenko dealt with the nature of circulations over Antarctica and surrounding oceans, and papers by I. S. Kerr and S. Karelsky also treated this subject, using a synoptic climatological approach.

Reviewing the session, the chairman stated that the papers presented appeared to belong to two categories: (*a*) model experiments or theoretical treatments of circulation features, and (*b*) deduction and inferences regarding circulations based on synoptic studies. He thought that R. H. Clarke's paper was of value, not only because the model exactly simulated atmospheric behaviour, but because observation of the processes occurring in the model could stimulate ideas regarding the circulation of the atmosphere. He also thought that the group of papers based on synoptic studies indicated that there was a general agreement among meteorologists regarding the occurrence and behaviour of the large-scale features of the circulation over Antarctica and surrounding oceans. He pointed out that, in Antarctica, a network density has been achieved which enables a reasonably accurate charting of large-scale circulations, but that, over the surrounding ocean areas, the network was not adequate to arrive at reliable circulation concepts.

5th Session. Snow and ice characteristics. Chairman, G. de Q. Robin.

An instrument which has been designed for the measurement of snow drift was described in a paper by M. Mellor. A study by M. Mellor and U. Radok discussed the results of observations obtained with this instrument, concluding that "saltation" occurred near the snow surface in a manner similar to that observed with blowing sand. They found that snow drift transport was apparently much larger than previously believed, and suggested that it could form an important item in the mass budget of the ice sheet. The method of formation of puddles in sea ice was discussed by Y. Takahashi, and K. B. Mather discussed the results of observations of sastrugi, suggesting some relationships with wind directions.

Summarizing the discussion, Dr Robin said that the papers were of interest both to glaciologists and to meteorologists. The work on methods of measurement of snow drift and discussion of results indicated considerable progress in this field, but knowledge of the subject is likely to remain incomplete for some considerable time. He remarked that observations of the occurrence of puddles in sea ice seemed to agree admirably with theoretical considerations, also that the question of sastrugi was of great interest, but care must be taken not to infer a detailed relationship with wind direction which, in fact, may not occur.

6th Session. Heat and mass exchanges. Chairman, C. H. B. Priestley.

F. Loewe reviewed the various items in the mass budget of the Antarctic ice sheet and M. J. Rubin dealt with advection of sea across the Antarctic boundary. J. F. Gabites discussed the role of the Antarctic in the general circulation of the atmosphere by estimating the individual items of the heat budget. A paper by W. B. Moreland gave a comparison of the observed structure of the stratosphere over Antarctica in winter with that obtained from a consideration of infra-red cooling rates from theoretical models. J. MacDowall commented on observations of ozone at Halley Bay.

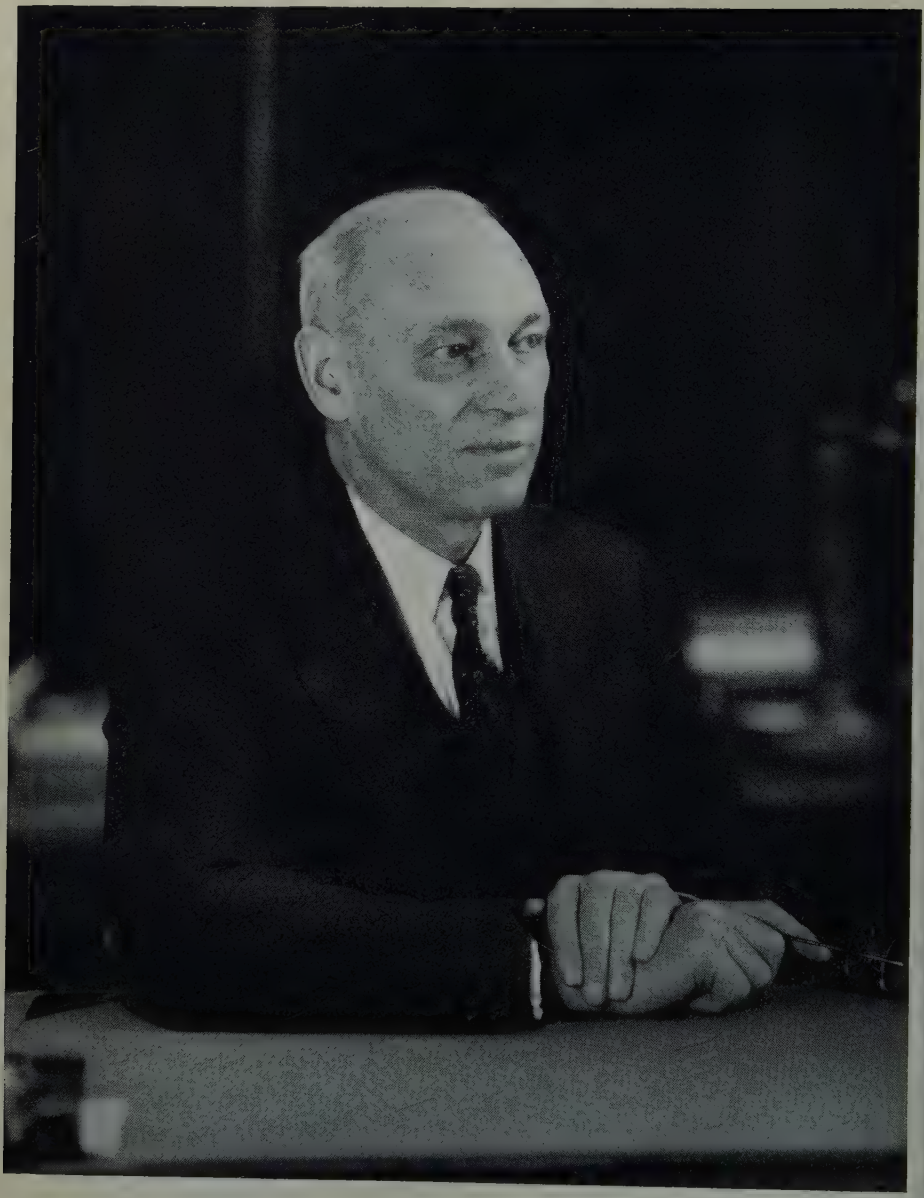
Dr Priestley, in reviewing the subject of exchange processes, pointed out that it is in this field that quantitative values are allotted to large-scale physical processes, and remarked that the degree of unbalance in the exchange budget provides a yardstick to measure the progress in knowledge of the subject. He indicated that there are various types of exchange studies; one in which an attempt is made to draw up a complete balance to see whether any systematic change is occurring, another in which values are assigned to a number of terms in order to arrive at one otherwise unknown, and a third in which, after having inferred the magnitude of a missing term, its value is obtained by computing it from another method. Dr Priestley thought that Gabites's paper was a major work and would be a valuable reference for the Southern Hemisphere for many years. He drew attention to the fact that exchange studies provide a guide as to the desirable network density in Antarctica. He suggested that the main reason for the study of local meteorology in Antarctica was to be able to isolate the effects of local phenomena.

7th Session. Climatological aspects of the Antarctic. Chairman, J. J. Taljaard.

A paper by H. Wexler discussed the annual variation of temperature in the Antarctic and suggested that horizontal advection of maritime air in the Antarctic troposphere, and the restriction of advection by the strong stratospheric jet stream encircling Antarctica, were important factors. Climatological studies of certain Antarctic localities were presented by J. Zimmerman and J. MacDowall, and a brief summary was given of a major study of the meteorology of the South American Antarctic sector by W. Schwerdtfeger, L. M. de la Canal and J. Scholten. The upper air climatology over the South Pole was discussed in a paper by E. Flowers, and R. C. Taylor presented mean monthly cross-sections from pole to pole.

Commenting on this session, the Chairman said that the need for climatological statistics and derived charts or documents of the Antarctic is in general different from the requirements of the remainder of the globe. There was likely to be little demand for climatological studies for permanent settlements or other utilization of the Antarctic continent; the requirements for climatological data from Antarctica and surrounding oceans is based on its role in the local, regional and general circulation of the atmosphere and its part in determining exchange processes. He thought that the conventional climatological analyses for individual locations in Antarctica were not sufficient, but must be supplemented by preparation of climatological charts for Antarctica and surrounding oceans. He suggested that it might be difficult in the near future to improve upon existing climatological charts for the ocean areas (such as those published by the South African Weather Bureau), but that considerably improved charts and statistical studies should be possible for the Antarctic continent within the next few years.

A report of the symposium, including copies of papers presented and summaries of discussions, will be published by Pergamon Press, London.



CHARLES CAMSELL

Courtesy of National Museum of Canada

(*Facing p.* 609)

OBITUARY

CHARLES CAMSELL was born on 8 February 1876 at Fort Liard, in the Mackenzie River district of the Northwest Territories, and died in Ottawa on 19 December 1958. His father spent 40 years as a factor in the Hudson's Bay Company and, of his eleven children, ten were born at trading posts 2000 miles from the nearest doctor, where mails came twice a year and supplies only once. At the age of eight, Camsell left home to join his elder brothers at school in Winnipeg, remaining there until he graduated from the University of Manitoba in 1894. He then journeyed north to visit his family at Fort Simpson and began ten years of the most varied and strenuous life; he built and taught for an Anglican Mission, made a disasterous attempt at fortune hunting in the Klondike goldfields, and surveyed for two railway companies in between periods of post-graduate study at Queen's University, Kingston, Harvard University and the Massachusetts Institute of Technology. Only his admirable autobiography *Son of the North* (Toronto, 1954) can give a picture of the scope of his travels and adventures during those years, and, indeed, for sixteen years afterwards until the responsibilities of a senior government post chained him to a desk. By canoe, scow, and on foot, leading large parties of geologists or with only one or two companions, Camsell covered more of the then unknown north-west of Canada than any man had done before him. In 1900 he joined J. Mackintosh Bell exploring the Great Bear Lake for the Geological Survey, an association that decided him to become a geologist himself. Investigations of a report made by him during that venture led to the pitchblende discoveries on the shores of Great Bear Lake in 1929. In 1904 he joined the Geological Survey of Canada, and was responsible for the exploration and mapping of some of the larger rivers in north-western Canada, notably the areas around the Severn River, Peel River and Taltson River. In 1914 he was appointed the first "Geologist in charge of exploration". He became Deputy Minister of Mines in 1920, and of Mines and Resources in 1935, the year he received a C.M.G. from King George V. He was appointed to the Council of the Northwest Territories in 1921 and was Commissioner from 1935 to 1946. He served with distinction on a large number of national boards and committees, and represented Canada on a number of international conferences. Among the many honours he received was the Founder's Medal of the Royal Geographical Society.

Charles Camsell occupied a unique place in the recent history of northern Canada; in addition to his wide geographical knowledge he had a direct and personal knowledge of every important development in that country during the Twentieth Century.

AUGUSTINE COURTAULD was born in 1904 and died on 3 March 1959. In 1926, when an undergraduate at Trinity College, Cambridge, he accompanied J. M. Wordie's Cambridge East Greenland Expedition as a photographer. The party spent the summer surveying the coastline of the Keyser Franz Josephs Fjord area of east Greenland, between Pendulum Øer and Davy Sund. In 1929 Courtauld returned to the same area with another Cambridge expedition, also led by Wordie. This time he assisted R. C. Wakefield in the survey of Nordenskiölds Gletscher and Petermann Bjœrg, at the head of Keyser Franz Josephs Fjord.

His next visit was with the British Arctic Air Route Expedition, 1930–31, led by H. G. Watkins. The possibilities of an air route between the United Kingdom and Canada were being investigated and the object of the expedition was to obtain information about the least-known part of the route, the east coast and central ice sheet of Greenland. A base was established about 40 miles west of Angmagssalik. One of the main activities of the expedition was the establishment of a meteorological

station on the ice sheet, about 125 miles from base, from which continuous meteorological observations were made for seven months. Courtauld took part in two journeys to the "Ice Cap Station". In October 1930 he was one of a party sent to relieve the station. Weather delayed their arrival until 3 December, by which time there were not sufficient stores and fuel left to support two men until the next relief. Courtauld volunteered to remain there by himself, and spent five months alone until he was relieved on 4 May 1931. During this time he kept up meteorological observations regularly until, early in April, he became snowed in and ran seriously short of fuel. He later took part in an adventurous small boat journey around the southern tip of Greenland to Julianehaab on the west coast.

His last visit to Greenland was in the summer of 1935. He joined forces with L. R. Wager's expedition to Knud Rasmussen Land, in order to explore the Watkins Bjœrge in the Kangerdlugssuak district. A party of five landed at Kap Irminger and, in three strenuous weeks, crossed Christian den IV's Gletscher and reached the summit of the highest peak in the range, 3700 m. (12,200 ft.).

During the Second World War, Courtauld served in the Royal Navy and, in later years, became successively Deputy-Lieutenant and High Sheriff of Essex. He published an autobiography, *Man the Ropes* (London, 1957), and edited an anthology of polar writings, *From the Ends of the Earth* (London, 1950).

Sir James Wordie writes:

"August Courtauld was probably the best known of English arctic explorers in recent times. His name became almost a household word and few people did not know of his lonely wintering on the Greenland plateau. When it became known that there were not provisions for more than one person during the winter months Courtauld immediately offered to stay alone and be that single person alone on the Greenland plateau. This ensured that the weather observations were carried on without any break and that Watkins, who at that time was pioneering an Arctic air route, could rely on a record of weather conditions during the whole period. This was only possible if the number of men on the plateau could be kept below two and Courtauld therefore undertook to remain. His spirit luckily responded to such a stimulus, and by his nature he was just the man who would not suffer unduly. He was on Petermann Bjœrg both in 1926 and in 1929, on the first occasion on the Cambridge Peaks near the mouth of Kjerulfs Fjord, and on the second on the actual climbing of Petermann Bjœrg, where his backing with Vivian Fuchs of Forbes and Wakefield was typical of Courtauld's qualities, and one of the things which made him such a lovable and popular member of any party."

James Travis Jenkins died on 12 January 1959 at Capel Dewi, Llandyssul, Cardiganshire. Born in 1876, he was educated at the Merchant Venturers' School, Bristol, and at the University of Wales, where he began to specialize in marine zoology. In 1904 he was appointed Superintendent of the Lancashire and Western Sea Fisheries Joint Committee. He held this post until his retirement in 1946, with the exception of only one short period, 1908–10, when he was seconded to the Bengal Government to investigate and organize the fisheries of the Bay of Bengal. His work was primarily the study of the inshore fisheries of the Committee's district, but he will be chiefly remembered for a series of books relating to fisheries and fishes. Of special polar interest were: *A History of the Whale Fisheries* (London, 1921), *Whales and Modern Whaling* (London, 1932), and *Bibliography of Whaling* (London, 1948).

Per Kampmann, the Danish engineer and entrepreneur, was born in København on 31 May 1892 and died on 7 April 1959. He played an important part in the building up of Scandinavian Airlines System and provided much of the initiative in the

rmation of Nordisk Mineselskab, the company which is exploiting the lead and zinc eposits at Mesters Vig, east Greenland. He had been chairman of the company since)52.

Augustinus Telef Nis Lynge, representative for south Greenland in the Danish olketing, was among those lost with the Danish vessel *Hans Hedtoft* at the end of anuary 1959. Lynge, a Greenlander, was born at Fiskeraesset on 18 October 1899. [e qualified as a teacher, and then went to Denmark for three years' further training. n his return he was appointed to a post at the Godthåb teachers training college. [e published a novel, *ukiut* 300-*ngornerat*, and, from 1934 to 1948, produced a periodi- al *tarqigssut*. He also wrote text-books on zoology, geography and Greenlandic. In 941, he founded the youth association "nunavta qitornai". Lynge took a promi- ent part in the public life of Greenland as a member of the Godthåb kommunerad Communal Council], a delegate to Rigsdagens Grønlandsudvalg [permanent parlia- nentary committee for Greenland], a member of the landsrad [Provincial Council] rom 1951–55, and finally as one of the first two representatives from Greenland in he Danish Folketing.

Poul Ludvig Rasmussen was captain of the *Hans Hedtoft* when it was lost with all n board at the end of January 1959. He was born on 5 February 1901. He obtained is master's certificate in 1928, and was first employed by Den Kgl. Grønlandske Iandel in 1929. He took part in Lauge Koch's expedition to east Greenland in 1931– 4 as second mate and radio operator on the *Godthaab*, and was master of the *God- haab* during Eigil Knuth's Pearyland expedition, 1947–50. He was later master of he Greenland X-ray ship *Misigssut*.

ERRATA

The *Polar Record*, No. 60, September 1958

Page 242, line 16. *For* Serpalov *read* Serlapov.

The *Polar Record*, No. 62, May 1959

Page 463, line 30. *For* P. J. Friend *read* P. F. Friend.
Page 482, line 3. *For* 52′ *read* 32′.
Page 489, line 28. *For* Framlingham *read* Framingham.
Page 525, line 3. *For* Orme *read* Orne.

RECENT POLAR LITERATURE

his selected bibliography has been prepared by R. J. Adie, Terence Armstrong, T. H. llison, Amorey Gethin, J. W. Glen, W. B. Harland, H. G. R. King, Brian Roberts and nn Savours. Its main field is the polar regions, but it also includes other related subjects ıch as "applied" glaciology (e.g. snow ploughs and ice engineering). For the literature on ıe scientific study of snow and ice and of their effects on the earth, readers should consult ıe bibliographies in each issue of the *Journal of Glaciology*. For Russian material, the ystem of transliteration used is that agreed by the U.S. Board on Geographic Names and ıe Permanent Committee on Geographical Names for British Official Use in 1947 (*see Polar ecord*, Vol. 6, No. 44, 1952, p. 546).

Reprints of "Recent Polar Literature", from Nos. 37/38 onwards, can be obtained eparately (to allow references to be cut out for pasting on index cards) from the Institute, rice 2*s*. 6*d*. for two reprints. Copies will be sent without charge to organizations with which ıe Institute maintains exchange arrangements and which notify their wish to receive them. eaders can greatly assist by sending copies of their publications to the library of the ıstitute.

To increase the usefulness of the bibliography entries have been arranged provisionally ıder subject headings in classified order according to the Universal Decimal Classification. /hen circumstances permit the decimal notation will be included, together with a key.

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PRINTED IN GREAT BRITAIN AT THE UNIVERSITY PRESS, CAMBRIDGE
(BROOKE CRUTCHLEY, UNIVERSITY PRINTER)